new scientist

11 September 1975
Vol 67 No 966
Weekly 20p

Australia 60 cents/
Canada 75 cents/
New Zealand 60 cents/
South Africa 60 cents/
USA (by air) $1.50/
FF 5.20/DM 3.00/
skr 5.40/Spain 40 pts/



Whither balneology?

We provide the music.



You call the tune.

With GEC you play it your way. For GEC's Remote Job Entry Terminal, the GEC 2050 RjE, is designed to operate as standard with IBM and ICL mainframes and can communicate with *any* make of mainframe. And now GEC has HASP, VS1, and VS2 emulators available to provide even greater flexibility of operation.

Installed at any number of remote points, the GEC 2050 RjE enables you to make the maximum economic use of your mainframe computer. It can handle multileaved information at a speed of up to 9600 bits per second.

Hopper-loading for instructions and data, tape cassette-loading for programming, and the pressure of a single key for operation – it's as simple as that.

You would like some further information, wouldn't you? Comprehensive facts and figures are available on request.

GEC

GEC Computers Limited,
Elstree Way, Borehamwood,
Hertfordshire, WD6 1RX. Telephone: 01-953 2030
Extensions: 3799 or 3835. Telex: 22777
Answerback: Ellauto Borhwd.
A subsidiary of the General Electric Company Limited

new scientist

New Science Publications
128 Long Acre, London WC2E 9QH
Telephone: 01-836 2468
Cables: Newscient London WC2
Telex: 27253
Subscription enquiries: 01-242 4477

11 September 1975 Volume 67 Number 968

Editor: Dr Bernard Dixon
Deputy Editor (Science): Dr Peter Stubbs
Deputy Editor (Technology): Nicholas Valéry
Managing Editor: Richard Fifield

Science Policy Editor: Dr Martin Sherwood
Science Editor: Dr Roger Lewin
Assistant Science Editor: Dr Robert Walgate
Social Editor: Ian Low
Technology Editor: Michael Kenward
Technology Policy Editor: Dr Joseph Hanlon
Technology News Editor: Lawrence McGinty

Art Editor: Tom Reynolds
Assistant Art Editor: Chris Jones
Artists: Nell Hyslop, Michael Peyton

US Editor: Graham Chedd
72 Addington Rd, Brookline,
Massachusetts 02146

Consultants
Biochemistry: Dr Robert Freedman
Computers: Hedley Voysey
Developmental biology:
Dr Brigid Hogan
Education: John Delin
Environment: Jon Tinker
Marine: Tony Loftas
Psychology: Dr Nick Humphrey
Soviet Science: Dr Sarah White

Advertisement manager : Roy Edwards
Advertisement production : Enid Broderick

Advisory Panel
Sir Monty Finniston FRS
Sir William Glanville FRS
Dr Basil Mason FRS
Professor Sir Michael Swann FRS

Monitor	572
Technology review	586
Feedback	592
Westminster scene	604
Washington view	604
View from the country	605
Economics	606
Boston notebook	607
Out and about	607
The last word	608
Tantalizer	608
Letters	609
Grimbledon Down	609
Ariadne	624

Comment Tony Loftas, Hedley Voysey, Jon Tinker, Richard Fifield 570

Balneology in Britain John Dawes 576

To spin or not to spin . . . Royston Millmore 579

Collagen—the universal body builder
John Woodhead-Galloway 582

Engineering a solution Lawrence McGinty 590

Hydrography needs new paymasters Tony Loftas 594

Reprint requests abolished William Chan 597

Review Madeleine Simms, Professor John Cohen, Jon Tinker, Stanley Thomas, David Boas, Richard Fifield, Laurence Draper, Professor Patricia Clarke, Theya Molleson, Professor Robert Weale 598

Cover illustration by Mick Brownfield

This One



SJHO-1XD-BNPC

PUBLISHED WEEKLY

Publisher's subscription rate, inland: £12·50
Overseas surface mail: £13·75
USA and Canada (airfreight) $37·50
Back numbers (cash with order) 50p
Including postage from IPC Magazines Ltd, 66-69 Great Queen Street, London WC2E 5DD
Registered at The Post Office as a newspaper and printed in England
2nd class postage paid at Jamaica NY, 11431
Airfreight and mailing in the USA by Publications Expediting Inc., 200 Meacham Avenue, Elmont, NY 11003

© IPC Magazines Ltd, 1975

OVERSEAS ADVERTISEMENTS REPRESENTATIVES

USA: Jobson, Jordan, Harrison & Schulz Inc., 57 Post Street, Suite 712-715, San Francisco, California 94104 (415) 392-6794, and 1901 West Eighth Street, Los Angeles, California 90057 (213) 483-8530
East Coast and Mid West:
William F. Strube & Associates Inc. 230 Park Avenue, New York, NY 10017 (212) 686-7642

CANADA: Clement Dick, Chimney Copse, RR No 1, Churchill, Ontario, Canada. (705) 456 2341

JAPAN: International Media Representatives Ltd, 1, Shiba-Kotohiracho, Minatoku, Tokyo, Japan. Tel: 502-0656, Telex: 22633

EUROPE: Advertisement Department, New Science Publications, 128 Long Acre, London WC2E 9QH. Tel: 01-836 2468. Telex: 27253. Cables: Newscient London WC2

Comment

End of cut-price hydrography

Since March this year a report on the future of the UK's hydrographic work, charting and surveying the oceans, has been under consideration by the government. The report's existence was mentioned during the April meeting of the Greenwich Forum, an informal group dedicated to discussion of the country's maritime needs. Professor Sir James Lighthill referred to a Hydrographic Study Group that has "reported so recently that we could not be told anything about its findings". In his closing address to the meeting, Frank Judd, Parliamentary Under Secretary of State for Defence (Navy), admitted that the report was on his desk. He concluded with some advice to the media to shun the sensational and to concentrate instead on "developing thought, questioning thought, criticism, constructive criticism about the really long-term gigantic tasks which lie ahead". Six months have now elapsed and little more has been heard on this crucial issue. It cannot be sensational, therefore, to wonder what has become of the report and what will happen to the Royal Navy Hydrographic Service in the light of cut-backs foreshadowed in the Defence Review.

The Hydrographer of the Navy also referred to the Hydrographic Study Group in his annual report released in May this year. He pointed out that until the final decisions are taken concerning the size and future employment of the fleet, no definite long-term survey plans can be made either in home waters or overseas. Meanwhile the deployment of ships for 1975 reflects the compromise between purely defence needs on the one hand and the increasing requirement to support energy and worldwide shipping on the other. At present, pending a statement to the contrary, the axe hangs over two ocean survey ships and one inshore survey craft, even though the value of their work in terms of non-military needs is demonstrable (see p 594). What is in doubt is whether the prime users of their services, principally the Department of Energy, can afford to pay for them.

The Hydrographic Study Group has put forward two programmes for the period up to 1985: one, the ideal, involves expansion rather than contraction of the Royal Navy's Hydrographic Service. The other uses the existing establishment as its basis. The ideal situation itself represents a compromise on identified needs, but even the more modest programme would find itself seriously short of funds unless more money is forthcoming from the Department of Energy and other departments presently using the Hydrographic Service on a cut-price basis. Although the immediate concern must be to have a decision on the future of the Hydrographic Service, the present dilemma reflects upon the Navy's other roles, such as the support of fisheries, marine research, off-shore activities and diving. The defence budget no longer seems the appropriate place for the allocation of funds. A separate vote is clearly indicated and, according to Mr Judd, is under active consideration. But will a separate vote really solve anything? In the final analysis, the government will still have to make additional funds available at a time when it is publicly committed to restricting expenditure as a matter of political principle.

Tony Loftas

Fresh options for ICL in Europe?

Those who would advocate a pan-European amalgamation of leading high technology companies in order to do battle more effectively with American and Japanese giants have a new brief in their portfolios. It arises from the sundering of Unidata, that Franco-German-Dutch computer firm so painfully put together two years ago by the managements of Compagnie Internationale pour l'Informatique (CII), Siemens and Philips under the coercion of their respective political patrons. However, since the French government embarrassed every one in May by buying into US controlled Honeywell-Bull and merging CII with it (see *New Scientist*, vol 66, p 447), the pan-European idealism embodied in Unidata seems to have evaporated somewhat. Last week came the expected announcement that Philips didn't really have the taste for carrying on and was closing down its end of the operation, making several thousand computer workers redundant in the Netherlands. This week comes word from Siemens, again as expected, that it will boldly soldier on as the sole backer of Unidata—until, that is, it can find another partner to share the bills. The US firm Univac has been mentioned, but Siemens has powerful ambitions in Europe which may prove too strong for any Atlantic alliance.

All this makes one wonder what precisely ought ICL to be doing in the midst of this vacuum. Certainly, the gaping opportunity that has suddenly emerged in the European computer industry is likely to convince some EEC technical mandarins that ICL should once again be prodded into re-evaluating its merger options in Europe. The timing is indeed propitious, although one wonders how precisely Siemens would greet such an overture—with its cash-flow being much stronger in the short-term than the British computer firm's. That aside, it should be pointed out that the obsession in Brussels with evolving a strong European computer challenge to the US domination should not be allowed to blinker ICL from studying other, more adventurous alternatives.

Given the technical strength of ICL and its limited grip on overseas markets, a better solution might well be to woo an international office equipment supplier such as Olivetti rather than any of the West German computer makers. The Italian firm is represented in a wide spread of countries and is totally complementary in its product line to ICL. This marriage of office equipment and data processing is clearly going to become increasingly important during the coming decade. The EEC's technical directorate must have recognised that Xerox and Philips are both really much more interested in the general office market than in mastering the "supercomputer" software maze—and have already taken steps towards muscling into the promising "word processing" market that IBM itself has singled out as the next great area for expansion. Many other experts agree that placing computers at the direct disposal of the office wordsmiths—from executives to secretaries and even humble filing clerks—will forge as big a revolution in the business world as wrought in the first place by giving computing power to the accountants.

Hedley Voysey

What price 20 million elms?

This summer's drought has made it clear that Dutch elm disease has created the biggest single catastrophe ever to hit the English landscape. South of a line between the Wash and the Mersey there are some 23 million elms. Of these, 6 million are dead or dying, and there seems little chance of saving more than a million or so of the remainder. The disease is caused by a fungus in the trees' vascular system, preventing water and nutrients reaching the leaves. It manifests itself as dead, brown branches in late summer, and this year's drought has accentuated the symptoms. The fungus, which is spread by a bark beetle, is now endemic to Europe and America, but the current English strain is more virulent than any so far identified; affecting elm varieties previously thought to be immune, it can also spread through neighbouring root systems.

The present outbreak started in 1969, and in spite of belated and half-hearted attempts to fell infected trees and burn the bark, virtually the whole of southern England is now beyond any control. The Forestry Commission at present has a dual policy. In lightly infected zones it encourages local authorities to establish *cordons sanitaires* around all outbreaks, and in badly-affected areas it merely forbids the movement of elm logs into disease-free districts. Given the limited resources available, this policy is sensible and realistic. Unfortunately, the commission has chosen to cloak its activities with misleading public statements which suggest it is mounting a concerted attack on the disease throughout the country.

For example, its latest announcement talks of "organised felling campaigns" and "all-out effort to save the healthy elms", and appeals to "anyone who sees an infected tree to report it to their local authority". In practice, only 34 out of 332 English district councils have any active anti-elm disease policy. As the areas where the outbreak is most obvious are precisely those where no action is contemplated, probably 99 out of 100 public observers of dying elms would be wasting their time in ringing up their district councils. Again, the Forestry Commission states glibly that "the Countryside Commission can give grants towards replacement planting"—omitting to mention that the current financial ceiling on such grants limits them to helping plant at most 100 000 new trees a year. Set against an expected death rate of 20 million elms in a decade, this response is derisory.

The truth is that the Forrestry Commission has done too little, too late, about Dutch elm disease. By its abortive compulsory felling policy of 1971, which it abandoned in 1972; by its failure to institute a ban on long transport until 1974; by its continuing predilection towards inane requests for public cooperation; and now by glossing over the fact that "the control position is hopeless" in most of England, it has built up a pathetic record of misjudgment and half-truth. Now, when the Treasury must somehow be persuaded to encourage the replanting of 20 million amenity trees costing at least £40 million, its voice has been severely discredited. *Jon Tinker*

Buoyant bioengineers

That Britain's bioengineering effort is taking on a new lease of life was obvious from the recent 15th anniversary meeting of the Biological Engineering Society (BES) in Edinburgh. That it should be doing so at a time of economic stringency is on one hand sad, yet on the other an advantage. The economic situation can only hinder the introduction of much new technology that stands in the wings waiting to enter the medical arena. A whole new range of new and tried electronics, for example, is poised, miniaturised, and ready to make the hospitals far less cluttered technically than they are now. We have also reached the threshold of a new era of non-invasive investigative techniques. Yet the same stringencies that are holding back development in these fields have forced the clinicians and engineers/physicists into a new reckoning. The voices that were crying out in the wilderness that "low technology" has too long been neglected in general medical practice are now being heeded. The creed is "beware the temptations of buying marginal improvements at increasing cost", and the litany is "deliver us from those who would invent the Concordes of medicine".

Like the crow that frightened Tweedledum and Tweedledee, though, the presence of the Department of Health in greater strength at Edinburgh than at previous BES meetings seemed almost menacing. The shadow it cast was the constant reminder that funds would become increasingly scarcer in the months ahead, limiting the purchase of equipment and leaving posts unfilled. Yet the clinicians and engineers were not downhearted, and instead of fighting over old rattles, they opened up new lines of communication. Achievements of the past 15 years were chewed over and their cost-effectiveness considered whenever possible. For example, it was reported that at Leeds computer-aided diagnosis for perforated appendix had resulted in a 10 per cent improvement in treatment, saving 3000 lives and probably £3 million annually. King's College Hospital, London, has reduced thrombus complications after surgery by 90 per cent following the introduction of its "peripheral heart" device during operations (*New Scientist*, vol 67, p 487).

Yet nobody seemed blinded by technology this time. There was agreement all round that much technological innovation in hospitals was failing because there was insufficient collaboration at the planning stage, and the blame was placed squarely on the administrators. Some participants felt that technological innovations were outpacing our abilities and skills to manage them. Others claimed that there was too much with machines and not enough with people. Most significant was that clinicians and engineers were trying to thrash out some of the central issues engulfing them. Is technology in medicine a success or failure? What are the ethics of prolonged life support, and who decides?

Although no clear cut decisions emerged, it was right that biological engineers should be airing their consciences in public. A call frequently repeated at the meeting was for the introduction of "clinical trials" for technical equipment before being released to the hospital system at large.

All this seemed light years away from the heady technique-orientated days of the BES meeting in Oxford five years ago (*New Scientist*, vol 46, p 99). What is most needed now is a (Zuckerman-type) career structure to be introduced for bioengineers and physicists in the health service. The BES has political teeth, and is well represented on the Parliamentary and Scientific Committee. Now that the relationship between clinicians and engineers is seemingly better than ever before, effort and time must be spent in achieving a career structure for the up and coming bioengineers. *Richard Fifield*

Monitor

Babies' brains reveal that verbal skills are inborn

While psycholinguists, inspired by the ideas of Noam Chomsky, have been seeking evidence for the innateness of human language in the peculiar structure of children's sentences, others have been looking for it in babies' brains. According to Tony Buffery—who pronounced at the Third Child Language Symposium in London last week that to talk about language without neurology was to build a Tower of Babel without foundations—they've found it.

The two keys to the discovery are lateralisation and sex. It is well known that linguistic skills are controlled in most people by the left-hand side of the brain. It is also well known that girls tend on average to be more adept at verbal skills than boys are. The question is, do these differences—both the lateralisation of function and the sex difference—appear as the result of learning and experience, or are they present at birth?

Buffery quoted some ingenious psychophysical experiments demonstrating the dominance of the left over the right hemisphere in "dichotic" listening situations (where you confuse the subject by feeding one message into his left ear and another into his right). But what most impressed the assembly of psycholinguists and phonologists, bogged down in Piagetian cognitive stages and Chomskian sentence structures, was the nice clean anatomy.

Geschwind discovered years ago that the brains of adults show an interesting difference between left and right hemispheres, in the lengthening and thickening of a small piece of the brain's temporal cortex on one side only. In 60 per cent of cases this was on the left. The same asymmetry has now been discovered in new-born babies. Moreover, in keeping with the idea of inborn linguistic adeptness, it is more pronounced in girls than in boys.

Although the cortical area in question lies in the right place for involvement in the comprehension of language, its exact function has not been defined. But the sex difference crops up time and time again in connection with asymmetry between the brain's hemispheres. A survey of 200 epileptic children showed that when the focus was in the left hemisphere the symptoms emerged before the age of two, but when it was on the right they generally appeared after the age of two. In girls, the switch from left to right hemisphere for the area of higher risk occurred earlier than in boys. And in certain tests on children before they are able to speak, girls tend to be more advanced than boys.

None of that solves the problem of what exactly is wired into the human brain to enable it to generate an infinity of different sentences. But it seems clear that we have innate linguistic surface structures in our brains even if there is no evidence for innate Chomskian deep structures in our sentences.

Hot stuff down under out West

Apart from the earthquakes, California is close to being the ideal place to live. The pleasant climate and geography are accompanied by many natural resources, including oil. Now, to cap it all, it seems that the geophysical processes associated with the Gulf of California may have produced "one of the Earth's most important geothermal resources."

The quote comes from a recent paper in *Nature* (vol 257, p 23) by Dr L. A. Lawver, of the University of California, Dr David Williams, of the US Geological Survey, and Dr Richard von Herzen, of the Woods Hole Oceanographic Institution. They have mapped a 3-km wide, high heat-flow anomaly within the ocean floor spreading region of the central Gulf of California. Although the potential of the region as a "mine" of geothermal power remains uncertain there is no doubting its interest to geophysics.

In the course of relatively recent tectonic history, the American continent drifting westward has overrun the northern continuation of the spreading East Pacific Rise. The San Andreas fault marks the boundary between the North American and the Pacific tectonic plates, and the Gulf of California is a transition region between the sideways fault movement to the north and the still spreading part of the Pacific ridge to the south. The Gulf is still opening, with Baja California pivoting anticlockwise, and provides a very convenient site for studying the spreading mechanism, although it is not exactly a typical spreading ridge.

The latest study was made last October during a cruise surveying the Guaymas Basin in the central part of the Gulf. The release of heat from a local region in the area can best be explained, say the Californians, in terms of an intrusion of basalt 1 km wide and 100 m deep beneath the basin, assuming an age of about 18 000 years. Seismic studies of the region, however, show a much larger intrusion, 4 km-wide, which must have taken 65 000 years to form at an average spreading rate of 3cm a year. The obvious explanation is that the prominent recent feature is simply the latest in a series of intrusions, so that the Gulf is being opened not by continuous spreading but in discontinuous episodes.

A 3-km wide heat flow anomaly producing 30 microcalories per sq cm per second is impressive enough, and the figures look even more encouraging when Dr Lawver and colleagues put them in terms of a temperature of 200°C at the interface between the seafloor sediment and the underlying rock. Other basins in the Gulf—especially the Farallon Basin to the south—may also contain hot intrusions, and there seems a real possibility of drilling for heat in the region.

A new storm brews up on Jupiter

Jupiter's South Equatorial Belt (SEB) is presently the site of a major disturbance which started about the 2 July, and is presently modifying the visible appearance of the planet. The storm started, like previous similar events, from a small white spot on the northern component of the SEB with a following dusky wisp. Initially the spot lay between SYSTEM II longitudes of 50° and 55°, while the Great Red Spot (GRS) was centred near 35°. By 5 July the disturbance was at latitude 15°S. Photographs taken on 7 July show it lying west of the GRS and beginning to spread out in an eastward direction (increasing longitude).

Disturbances of this type are not new. Since 1919 observers have noted that the SEB exhibits a series of semi-periodic fadings followed by cataclysmic returns to prominence. In all, they have seen a total of 12 previous SEB storms: 1919, 1928, 1943, 1949, 1952, 1955, 1958, 1962, 1964 and 1971; while in 1943 and 1971 *two* such events were seen.

Planetologists do not understand the origin of these disturbances, although they believe them to be associated with three "hot spots", regions of excess thermal emission located deep in the Jovian atmosphere approximately 120° apart. If the present SEB storm follows the previous pattern it will encircle the planet in about two months, leaving the entire belt in a state of turmoil. When the resulting eastward moving spots reach the GRS it should fade quickly; the planet will then begin to resume its normal appearance. During the next few months astronomers throughout the world will be observing the changing appearance of Jupiter in an attempt to understand the reasons for this cataclysmic change in the Jovian weather.

Evidence mounts against the "hot spot" theory

Oceanic volcanic islands and submerged seamounts which form linear chains have posed the oceanographers a real teaser. For, although the spreading ocean floors result in a distribution of volcanoes such that the youngest fall near the mid-ocean ridges, and the oldest towards ocean margins, in general most do not form compact linear features such as, say, the Hawaiian or Emperor chains of Pacific islands. Nor, as spreading would require, are the latter inclined at a right angle to any of the presently active Pacific ridges, such as the East Pacific Rise. They are too young to represent a line of sea-floor spreading of more ancient history. To account for such features, geologists in the last few years have advanced the hypothesis of oceanic "hot spots", relatively permanent heat sources located in the upper mantle over which the oceanic crust moves, generating a line of volcanoes as it goes. Preliminary age measurements of Pacific island chains have lent support to the idea by showing what seems to be a progressive increase from one end to the other. Some new age determinations, however, now cast strong doubts on the hot-spot theory—at least as far as it concerns the Hawaiian and fancifully named Musicians' Seamounts. Moreover, newly announced results from the recent probings of the US drill ship Glomar Challenger into the New England Seamount chain of the western North Atlantic imply that this very similar type of feature also lacks any age progression.

In the Pacific, David Clague and Brent Dalrymple of the US Geological Survey, Menlo Park, employed a relatively untried approach—they compared the potassium-argon ages of samples from the volcanic rocks of the Khatchaturian and Rachmaninov Seamounts lying some way to the north of the Hawaiian Ridge, and from those of the Wentworth Seamount and Necker Island forming part of that ridge, with the rocks making up the sea floor adjacent to each of these entities (*Geophysical Research Letters*, vol 2, p 305).

They found that the Necker and Wentworth samples yielded ages (60 and 40 million years, respectively) far too great to be accounted for by the hot-spot hypothesis. Instead, they believe, these two volcanoes are chance inclusions in the Hawaiian chain unrelated to the main group of islands. The statistics for island density in the Pacific make this a genuine possibility.

The two geologists next collated all the available data on the ages of seamounts and adjacent ocean crust for the north central Pacific, including their own determinations for the Musicians' Seamounts. Seven of these are reliably dated. "With one possible exception," they conclude, "the ages of these . . . Cretaceous seamounts in the north-central Pacific are less than or equal to the age of the adjacent sea floor indicating that the seamounts formed at or near the crest of the East Pacific Rise."

In the Atlantic Glomar Challenger won core samples from two of the New England Seamounts 180 miles apart during Leg 43 of the Deep Sea Drilling Project which took place in June, July, and early August. From these it appears that parts of the volcanic chain were simultaneously active 75 to 85 million years ago. Only very rapid movement across a hot spot would allow that explanation to work in their case.

Another finding on this leg is that Bermuda was an active volcano between 40 and 30 million years ago; and that it became eroded to sea level 25 million years ago, prior to reef formation.

The DSDP results also include the discovery of the most deeply submerged oceanic island ever—reefs 2½ miles down, drilled on the Grand Banks, show evidence of rain-water solution which happened 105 million years ago on a part of the ancient Mid-Atlantic Ridge which projected, like Iceland today, above the sea. A point of further interest about this borehole is the recovery of a particularly complete microfossil record from Late Cretaceous up into the Tertiary which could be important for telling what happened 65 million years ago, at a time when not only many marine animals but also the dinosaurs became extinct.

How cerebral are sexual cycles?

Raquel Welch (or some such person) is credited with the remark that a woman's principal erogenous zone is her mind. That is not quite tantamount to the proposal (this time by a psychologist, Frank Beach) that primates are freed from their hormones by their forebrains—and while she may be right, it seems from some recent voyeurism on gorillas that Beach is wrong.

The sexual machinery of the lower animals is completely entrained to the hormonal cycle of the female. When, for instance, a female rat is ovulating (in oestrus) she becomes both receptive and attractive, and copulation follows like clockwork. That is not the case for man who indulges in sexual activity at any stage of the menstrual cycle, or indeed in its total absence. The same goes for chimps, apparently, and since the forebrain appears at about the same point in phylogeny as continuous copulation, Beach suggested that the one might be the cause of the other.

Not, however, according to Ronald Nadler's data on gorillas (*Science*, vol 189, p 813). Gorillas occupy, as he points out, a reasonably advanced position is phylogeny and have quite a respectable endowment of forebrain. But they also seem to be locked into a regular copulatory cycle determined in a thoroughly primitive way by the female's oestrus cycle. Nadler counted copulations in four male and nine female gorillas while monitoring the hormonal state of the females (by looking at their bottoms—or perineal labia, to be precise) and found that neither male nor female gorillas showed any serious interest in sex unless the female was in oestrus, when she became thoroughly sexually aggressive and the male accordingly obliged.

That is not to say, however, that gorilla sex is entirely mindless. There were two aspects of sexual behaviour that redeemed it from the realm of the purely mechanical. First, Nadler noticed that the degree of interest of the females in oestrus varied, possibly because of preferences for particular males. And second, the positions for copulation were not always the same, even within the same pair of gorillas, but varied between front-to-back and front-to-front.

From Beach's point of view, the significance of Nadler's findings is that the forebrain must have a rather variable effect on the hormone-dependence of sexual behaviour. Chimpanzees are less tied to their hormones than gorillas, but, according to Nadler's preliminary impressions, more so than orang-utans (who remain to be studied in detail).



Mothers give infants tolerance

American immunologists Robert Auerbach and Susan Clark claim that the mother has more effect on the development of the foetus's immunological defence system than has previously been realised. In experiments on mice they show that specific tolerance to antigens can be passed from mother to offspring either via the placenta or in the milk.

Auerbach and Clark have examined induction of specific tolerance to foreign red blood cells using a soluble fraction of cells in adult mice. This tolerance was optimally transmitted to offspring when the toleragen was injected into the mother some two to five weeks before pregnancy began.

This time lag, according to Auerbach and Clark, implies that the active "tolerising" agent is probably a complex of toleragen and specific antibody, something that could easily pass the placental and lactation barriers. This kind of tolerance may be important in the continued expression of the so-called vertically transmitted diseases, including certain cancers. (*Science*, vol 189, p 811).

The crust of Mars in a state of imbalance

A new analysis of Martian gravity, derived from Doppler tracking of Mariner 9 in 1972, strongly indicates that, while the older topographic features of Mars are apparently in isostatic equilibrium, relatively young features—such as the great volcanic plateau of Tharsis—are not. Taken with its adjacent, similarly unbalanced, lowlands of Chryse and Amazonis this great uplifted region must represent the massive redistribution of Martian material which has not—or not yet—adjusted itself to the planet's gravitational field.

Over nearly all of the Earth's surface, the topography is in isostatic equilibrium with the underlying mantle. That is, if the lighter crustal rocks are regarded as floating on the denser, plastic rocks beneath, they float at their stable heights. Where there is a mountain range it has compensating "roots" of lighter rock like the submerged part of a ship. Depressions in the crust, conversely, float higher on the substratum. However, we now know that the Earth has a pretty mobile crust, implying a mobile upper mantle. Signs of crumpled mountain belts or drifting continents are conspicuously absent on other terrestrial planets. Are these bodies too rigid and, if so, do they also show large departures from isostasy?

The new map of Martian gravity, derived from 92 "surface mass points", is the work of W. L. Sjogren and J. Lorell of the Jet Propulsion Laboratory, in conjunction with L. Wong and W. Downs of Aerospace Corporation, Los Angeles (*Earth and Planetary Science Letters*, vol 80, p 2899). They remark that if Tharsis—"a unique feature in the solar system"—were removed from the data, the rest of the planet would appear to be close to isostatic equilibrium.

This theme is developed in the preceding paper in the same issue of the journal (p 2893) by R. J. Phillips and R. S. Saunders of JPL. By plotting observed gravity values against those derived by calculation from the topographic map they show that there are two distinct populations of Martian features: those they label "older" which include the Hellas and Isidis basins, the region termed Thaumasia, the Solis Planum, and the Martian cratered uplands; and the "younger" Tharsis, Chryse, and Amazonis areas. While the older terrain appears to be isostatically compensated at a depth of about 100 km, the younger features are only partially compensated—although the depth of partial compensation could well be also at around 100 km. Is this to argue Phillips and Saunders, the base of the Martian crust?

Clearly an analysis of this type can tell us quite a lot about the interior of Mars. For even the younger features are between 100 million and a billion years old. For them to have withstood the inward pull of gravity so long would call for a very high viscosity in the Martian mantle—at least 10^{25} Ns/sq.m—or else that the planetary interior is rigid against solid-state creep of the kind envisaged within the Earth. If it is now, it was presumably not always so, or the older topography would never have reached the equilibrium it clearly reveals.

Chemistry on the islands of stability

Dmitri Mendeleeff, as long ago as 1869, made an enormous contribution to chemistry by classifying the known elements of the time (about 56) in the Periodic Table. He used the periodicity of properties of the elements and their atomic weights to order them in the table with groups (vertically) and periods (horizontally). Wherever elements didn't fit the pattern he left a gap and predicted the likely properties of the then unknown element. With all the gaps now filled, nuclear physicists and chemists are trying to extend the Periodic Table by synthesising more transuranic elements. Simultaneously, theoreticians are trying to predict the likely properties for some of these elements to help the practical men to know which ones to aim for.

Certain nuclei are more stable than others and nuclear theory suggests that "islands of stability" will occur around elements 114 and 126. Predicting the chemical properties of these super-heavy elements is complicated by the fact that any calculations of data such as bonding energies need relativistic corrections. The calculations concerning bonding in simple compounds (oxides, etc) depend on the orbital into which the theoretician decides to put the outermost valence electrons. Using this type of relativistic calculation (and some old-fashioned chemical common sense), Kenneth Pitzer of the Lawrence Berkeley Labs, recently predicted some of the properties of elements 112, 114, and 118.

Writing in the *Journal of Chemical Physics* (vol 63, p 1032) Pitzer first estimates the physical properties of elements 112 and 114 from the promotional energies (those involved in the quantum number increase accompanying the formation of a compound) and heats of sublimation of other Group 2 and 4 elements. Surprisingly he reports that both ought to be gases or very volatile liquids at room temperature! Applying the same procedure to the Group 2 series zinc-cadmium-mercury, indicates that mercury ought to be a very volatile liquid—which of course it is! In agreement with other researchers he shows that element 118 will most probably be gaseous.

More complicated is the estimation of stability for the covalent compounds of these elements. Pitzer calculates that only the fluoride of element 112 will exist whereas for element 114, the chloride, bromide and fluoride will be stable. The oxides, however, will probably be unstable. Since one of the main problems with transuranic elements is separating them once you've got them, the predicted great volatility and ease of reduction to the element means that when elements 112 and 114 are made it should be quite easy to isolate them.

I	II	III	IV	V	VI	VII	0
							He 2
		B 5	C 6	N 7	O 8	F 9	Ne 10
		Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
111	112	113	114	115	116	117	118

Part of the Periodic Table containing the "inert" gases and the "b" groups

Now chromosomes have import problems too

Evidence is growing that one way in which cells may be influenced by each other and by geneticists is by taking in foreign DNA. The process is familiar with DNA from viruses, and has now also been shown to happen with chromosome DNA by Klaus Willecke and Frank Ruddle at Yale, and by John Burch and Wesley McBride at Bethesda. (*PNAS*, vol 72, pp 1792, 1797.)

The Americans have confirmed experiments first done by McBride two years ago, in which mouse cells lacking a gene for an enzyme apparently acquired the gene from isolated chromosomes from Chinese hamsters. The Yale workers have also used human chromosomes as donors, and the enzyme produced in the resulting cells is clearly that of man, not of mouse. The cells only acquired a small fraction of all the chromosomes' genes, and even this was quickly lost. But in McBride's original experiments, the new gene was sometimes properly inherited, so it seems that animal cells, like bacteria, may be able actually to insert foreign DNA into their own genomes.

But the fungus Neurospora has an even more peculiar ability, according to E. L. Tatum and his colleagues N. C. Mishra and M. C. Niu in New York and Philadelphia (*PNAS*, vol 72, p 642). Mutants of the fungus have had their inactive gene restored by treatment not with DNA, but with RNA, from normal Neurospora, and have now been inheriting it for over two years. This implies that some form of the semi-mythical reverse transcriptase of normal cells is probably present to convert the RNA to chromosomal DNA, and this must renew interest in what such an enzyme might be doing there. But the biggest puzzle is why cells should want foreign nucleic acids at all; is it for their genes, or their nucleotides, or for some other function?

Uniqueness and repetition in the organisation of genes

Most organisms seem to be amazingly profligate with their genetic material, the majority of it often appearing to be unrelated to gene expression. A comparison of fruit fly and mosquito DNA throws more light on this problem.

The fruit fly Drosophila melanogaster and the mosquito Aedes albopictus are both members of the same insect order, Diptera, and to all appearances are built on much the same basic design. It came as something of a surprise, therefore, when Dr Sheldon Penman of the Massachussetts Institute of Technology speculated during a recent talk at the National Institute of Medical Research that underlying this external similarity the DNA of the two insects may be organised in very different ways. This raises the possibility that the strategy for reading out the information stored in the genes is also very different in the two organisms.

To begin with, the mosquito has about six times more DNA per nucleus than Drosophila. This is one example of the so-called "C paradox" found throughout the animal kingdom: members of the same order may have widely different amounts of DNA (the C value) in their chromosomes, even though the organisms do not appear to be very different.

Like all other animals studied, Drosophila and Aedes have several classes of DNA sequences represented in their chromosomes. The major class consists of so-called "unique sequences" or stretches of DNA between 1000 and 4000 nucleotides long which are only present in two copies per genome (one in the maternal and one in the paternal chromosomes). The second class, or "highly reiterated" sequences, are stretches of DNA which are represented hundreds or thousands of times, and are mostly restricted to regions of the chromosomes known as the centromeres. Of greater interest are the "middle repetitive" which are represented about 50 to 100 times each.

Regulatory sequences

In Aedes, preliminary results show that these "middle repetitive" (MR) sequences are about 300 nucleotides long and most of them are interspersed fairly evenly between unique sequences on average 2000 nucleotides long. Since the class of "unique" DNA must contain the sequences of nucleotides coding for proteins, it is possible that the MR sequences act as regulatory sequences to which, for example, proteins involved in switching genes on and off can bind.

In contrast to the way that much of the DNA seems to be organised in the mosquito, in Drosophila both the middle repetitive and unique sequences of DNA are much longer. The MR sequences are, on average, 6000 nucleotides long, and most of them are interspersed with single copy sequences of more than 13 000 nucleotides. While some shorter MR sequences do exist, it can be calculated that there are enough of the longer MR stretches in the Drosophila genome to allow one to be present in each chromomere, or band, seen in the classical pictures of the giant polytene chromosomes of the larval salivary glands. This would fit in nicely with the idea that each band contains one control sequence and a stretch of DNA coding for one protein, but even this simple model does not account for all the DNA present in one band, and further experiments will obviously be needed to clarify the situation.

So far, Drosophila seems to be the only organism in which the DNA is organised in this way. Dr Eric Davidson and his colleagues in the Department of Biology at Cal Tech have collected from marine biology stations and elsewhere animals representitive of widely different evolutionary groups, and have found that a gastropod, a jellyfish, a sea urchin, an arthropod, various amphibia (including the well known Xenopus), and various mammals all have much of their DNA organised as short 300 nucleotide MR sequences interspersed with unique sequences about 2000 nucleotides long. However, the mosquito/fruit fly comparison is the first which has been made between closely related organisms with very different C values, and it remains to be seen whether the same difference will be found in other groups besides insects, or whether Drosophila is unique.

Certainly, further research into differences in the control of gene expression in the mosquito and fruit fly has been made much easier by the development in the laboratory of Dr Sheldon Penman of techniques for looking at messenger RNA and its precursor in continuous cell lines derived from embryos of the two insects. These cells can be grown in the laboratory in much the same way as human cells like the well known HeLa cell line, and in fact the same tissue culture medium can be used so long as it is diluted to the right salt concentration for insect cells.

In both mosquito and fruit fly cells messenger RNA is synthesised from the DNA in the nucleus as precursors considerably longer than the messenger RNA molecules which are finally transported into the cytoplasm to be translated into protein. Clearly the long precursors are trimmed down to size in the nucleus, but it is still not known why this very wasteful processing has to occur.

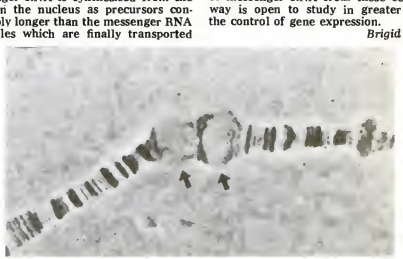
Significance of puffs

However, some difference seems to exist in the extent to which it is necessary in the two insects because the precursors are about three times longer in the mosquito than in Drosophila, even though the mRNA molecules which move into the cytoplasm are about the same length. It is possible that Drosophila has managed to organise its chromosomes in such a way that the DNA can be copied into much shorter mRNA precursors.

In the course of these experiments with Drosophila cells a very interesting discovery was made which is now being exploited in various laboratories interested in the way in which genes are switched on and off in animals. It had been known from earlier work with Drosophila larvae that if they were exposed to a high temperature (around 37°C) for a few minutes, then new bands on the polytene chromosomes of the salivary glands would puff up and become active in the synthesis of messenger RNA precursors and ultimately new proteins would appear in the cytoplasm of the cells (see photograph). Geneticists do not yet know whether this represents a normal physiological response of the larva, or whether it is a lucky artifact that new genes are switched on by such a simple procedure.

When the heat shock experiment is tried with the Drosophila cells in culture it turns out that a number of new proteins are made, and at the same time all the genes which were previously switched on are turned off (this also occurs in the intact larvae). Now that techniques are available for the isolation of messenger RNA from these cells the way is open to study in greater detail the control of gene expression.

Brigid Hogan



Two large puffs (arrowed) on a Drosophila polytene chromosome induced by brief heat shock (photo supplied by Michael Ashburner)

Balneology in Britain

The science of swimming pools—balneology—will become more significant if, as is possible, the private swimming pool grows to be as important as the bathroom is today

John Dawes
is a freelance journalist, specialising in the science and technology of swimming pools

As any practising swimming pool owner knows, keeping it clean is really a question of conservation. And this summer particularly has kept all the country's balneologists on their toes in the battle for coexistence. Economically speaking, a swimming pool can cost remarkably little to run. At least 50 000 "basins of water" exist around Britain, with almost as many conservation systems to keep them there.

Poolkeepers were among the earliest practising environmentalists and most of their engineering technologies were devoted to preservation. Nowadays the sophisticated system in the garden pool or the High Street baths strives "to maintain an existing body of water in constant condition"—a matter of considerable importance whenever we meet a heatwave. It is then that nearly everybody likes to cool off, and usually all at the same time, consequently stretching the purification processes to their limits, strengthening the bath managers' belief that "pollution is directly proportional to temperature".

Healthy water is no longer free, and purification schemes have to work day and night to obtain and to retain our potable water supplies at 250 litres per person per day. A cursory glance at a 100 000 cu. m/d capacity plant for clarification, precipitation softening, rapid sand filtration, and gas chlorination, immediately illustrates the advanced state of engineering in water wisdom. This technology is excellent for the water reservoir servicing the needs of a town of the size of Tunbridge Wells today. It is also ideal for the town baths of 1000 cu. m, coping with their heavy loads. But what happens when the pool reservoir is scaled down to 100 cu. m to suit an average family? By the very numbers of new pools installed each year (up to 5000 in the UK and 100 000 in the US) it is obvious that a practical solution has been found.



Tracked sliding cover for a private swimming pool (Courtesy Rutherford Swimming Pools Limited)

Water was precious in the mobile desert campaigns of the Second World War where cumbersome slow rate gravity sand filters could not be conveniently towed around. German kieselghur and Allied diatomaceous earth (DE) absorbants were the answer. Such fine spread media reduced filter tanks to a tenth the size of earlier gravity monsters, while keeping similar water flow rates through the filter bed. This rapid advance was seized on later by the Americans for their first pool boom in the 1950s; the DE filter units helped make the first million home pools possible. But flushing dirt and DE to waste added another ecological problem for drainage and sewerage systems, which a subsequent switch to "high speed sand" fortunately overcame. This time, coarser even grade sand beds, filtering in depth, increased the area rate of flow of water tenfold—a point of continuing contention which has ever since raised the hackles between innovatory and traditionalist water specialists. Regardless of viewpoint, the compact, hard working, rapid sand filter clarified the second pool boom in the 1960s, plus a bath bonanza in Britain.

Fine DE filters are now making a come back with recyclable media, bump-down rebedding devices and effective reclamation methods. More summers like this one, and the next expansion of rapid construction in leisure pools, will quickly take place regardless of recessions.

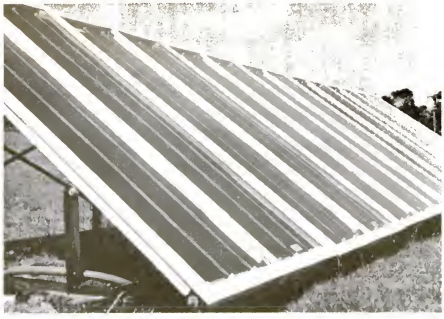
Changing water every ten years

The well-managed pool keeps its water for 10 years at a time. Straight forward filter units cost no more than 10 per cent of the price of the pool. And now the very same plant polishes effluent to a drinkable condition in the tertiary treatment of sewage—that important part of modern water treatment technology, where water is recycled more and more quickly.

In the swimming pool, it is not only necessary to ensure mechanical clarity and repetitive dilution, but there is also demand for total purity—the water must be "bug free". An abundance of organisms thrive in water; and the warmer the water the better! During a heat wave micro-organisms can cloud the pool in a day; stain and colonise in a week; and take over control within a month. Hence the need for chemical warfare.

Any knowledgeable pool owner knows that "water spreads diseases". His anti-microbe tactics include balancing pH with dry acid; super-chlorinating to raise rapidly the free chlorine concentration; flocculating excess salts for high total dissolved solids (TDS) or critically bombing algae colonies with slowly soluble calcium hypochlorite tablets.

The pool owner no longer makes titrative quantitative chemical analyses, but takes a



Solar converter bank for a swimming pool

simple two minute test with a tablet to measure disinfection levels, plus the diphenol purple to ensure 7·5 pH alkalinity. His stratagem to dispense a three-minute bacteria and algae kill-rate and get a free chlorine residual —with some surplus chlorine in the water— has inspired the design of efficient dosemeters to keep water sterile automatically all the time. Water treatment systems for swimming pools are quite capable of providing drinkable waters in the garden, inviting future architects to consider carefully this area of catchment designing.

There are many different and very reliable chlorinators and chlorogenerators. One fast developing device includes adding common salt to pool water so that an electrolytic cell can separate ions, freeing nascent chlorine from the very dilute brine solution. A similar ioniser releases pure silver that penetrates the bacterial cell walls to destroy them, while charged particles of copper are developed to kill algae and coagulate suspended solids This is a valuable aid, bringing rapid rate sand filtration down to less than 9 micrometres.

Swimming pool operators are ionisers. They use filters with even-sized particles, through which water can be pumped at a high pressure. These cells, with diverse applications in naval vessels, offshore oil rigs and hospital operating theatres, have to compete against ultraviolet irradiants, electrochemical sterilisers, brominators, and so on in achieving pool purity. Nevertheless, chlorine still tops the sanitation league, being either injected in gas form, broadcast as granules, or tipped in as a solution. Relatively low cost, large scale production ensures that most bathers actually swim in disinfectant without knowing it.

Free chlorine dissipates fairly rapidly in sunlight, and pool people seeking conservancy stabilise chlorine concentration with cyanuric acid—which acts as a UV filter or use convenient compounds with built-in chlorine locks like sodium dichloroisocyanurate.

The swimming pool industry has also pioneered roaming robotics to clear up dust and debris in water. One system employs a floating flailing sweeper to herd leaves together and put dirt in suspension for the filter to tackle. Another drops to the floor and, acting like a peripatetic filter, follows a random path all round the pool, grubbing up the fallen muck and mire. Then there are inlet swirlers, vacuum sweepers, or good old-fashioned hand-held brushes.

Pool as heat sink

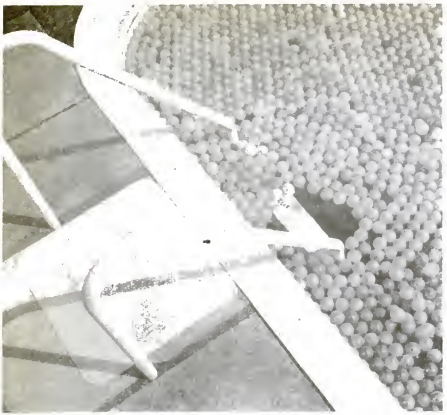
It is a fact that a small swimming pool heated wastefully adds 1000 per cent to the fuel bill, although the pool plus heater may be only 10 per cent more expensive to install in the first place.

Any decent sized body of water makes an ideal heat reservoir. A 10 m by 5 m pool is no exception. The pool slowly builds up heat, to release it equally slowly. Water temperatures increase by natural solar gain alone, from around 10°C in the spring to at least 20°C in the summer. The free donation of 10°C for 50 tonnes of water, not counting the concrete tank and surrounds, adds up to a valuable bank of kilocalories. Modern pool heaters take advantage of this build up and concentrate upon "topping-up" as necessary, rather than heating from ambient all the time. An unprotected poolwater surface loses 2° or 3°C overnight, even during a heatwave, mainly through radiation and evaporation. Total losses for 24 hours soon reach 5°C, which either solar gain or a heater has to make up the next day. A tolerable temperature for swimming is 25°C and always topping-up to this level above ambient gets increasingly expensive, especially in winter.

The cold facts of thermal conservation in pools are clear: insulate, recirculate, and finally generate. It is not necessary to waste fossil fuels to reheat a body of water to its previous state. There are better ways.

The conservationist principle of "integrated environmental design" (IED) introduces some interesting ideas when applied to a swimming bath. In the first place, obvious savings are soon obtained by having lower and less dazzling windows, smaller pool halls, radiant heating rather than total space heating, high thermal insulation and so, before you get around to recirculation of valuable heat. Recovery of heat from shower water, filter backwash, even the light fittings, soon amortises the cost of a heat pump. More dramatically, the heat transfer coil and thermal wheel within a ventilation duct can recover up to 93 per cent of total heat from the warm, moist air expelled from a building. Corrugated asbestos vanes, impregnated with dessicant lithium chloride, revolve at 20 rpm in the thermal wheel heat exchanger to collect heat from stale outgoing air and carry it round into the cool stream of fresh incoming air.

If applied to the garden pool, IED would be far more basic. A sunny aspect and sheltered seclusion are as important for the comfort of the bather as the protection of the pool. Surprisingly, in the UK it is usually con-



Plastic bubbles preserve pool heat without interfering with swimming. An unprotected poolwater surface loses up to 3°C overnight even in Summer

sidered worthwhile to insulate a swimming pool only when the pool is built in sodden ground. Subsoil watertables drain heat—which can be recorded up to 5 m away from the pool.

In Britain, it is at the water surface where most heat losses occur. Heat savings of 50 per cent are made simply by covering the water with a floating PVC blanket, foam padded and weld quilted. Alternatively, clear plastic sheeting with a sandwich of air bubbles inside, adds a solar trap on top of heat savings. A new idea uses a chemical to strengthen surface tension and reduce evaporation losses. Adaptions of the solar pond principle, where the Sun heats deep stratas of high density water almost to boiling point yet stores this heat beneath pure upper water insulating layers, might one day find a place in our saline, cosmetic conserved, swimming pool. Another very original heat preserver floats a carpet of ping-pong balls all over the surface of the pool. Swimmers just sweep them aside, so this cover never needs removing in order to bathe.

Fast, fossil fuelled, pool heaters are still the most popular and can be economical if operated intelligently. However, the large quantity of heat needed at relatively low temperature means that slow, low grade heat transfer systems, such as solar panels, are ideal for heat-hungry pools. The 100-year-old design of flat-plate solar converter has become the perfect pool heating panacea as it can donate on average in summer months, about 3000 kcal per day per sq. m of solar panel. The low operating temperatures in solar banks for pools encourages almost 100 per cent conversion efficiency. A large heat reservoir for solar energy is essential, and the social value of making the heat store also a swimming pool is an extra bonus. And in this summer a bank equal to at least half the pool's surface offers most attractive water temperatures, sometimes reaching 30°C, at no extra cost to the consumer!

Combating cold winters

The "reverse refrigeration"—heat pump—technique is used most successfully by at least one public pool. Heat is extracted from a nearby river by a heat pump which maintains at least 20°C water temperature from May to September for its 1100 cu. metre olympic pool at a cost reckoned to be 25 per cent below the previous conventional system.

Even in Moscow's harsh winters, bathers prefer swimming out of doors to "indoor" pools. It is no longer very practical to heat vast olympian outdoor baths in winter, and anyway most garden swimming pools usually hibernate for six months. In the search for a workable solution, all kinds of convertible buildings have been developed. Some open like an iris when the Sun shines—the latest French idea, which might be unnerving to the unwary. The Germans prefer suspended canopies hoisted like a circus big top, while the Americans have championed a pool-lid cover that hydraulically lifts up and away in two parts. The "big top" is pitched for bad weather, but the pool-lids stand on pivot arms to shield sunbathers from too much Sun. A Russian shelter deflects bitter winds on all four sides of the pool, but not on top where radiant heaters thaw poolside watchers. The Canadians prefer to cover this gap with an automatic sliding roof. In Britain, we roll a greenhouse type poolhouse apart on rails to let in summer Sun; we also have high hopes on researching the new science of bubbleology—all kinds of plastic hovercovers perpetually blown up by inflation.

The Romans came closest to solving the inside/outside problem for perfect life-style, by turning their backs on the streets, setting their villas to face inwards from all four sides, and looking into their own sheltered courtyard—the garden atrium. Nowadays, our "room in the garden", a descendent from the Romans, is a leading theme for landscape architects. The next stage of development is the balneum—a poolroom that joins house and garden. A small balneum set on the sunny side of the house stretches into the courtyard garden with glass screening panels separating the indoor spa pool bay from the leisure swimming pool extension outside.

In the 21st century a swimroom might be considered as necessary as the bathroom is today. Reviving the winter spa indoors—and those in doubt should visit hydro-conscious Germany—will in turn encourage building a summer pool outside. The potential pool-boom in the 1980s, and closing decade of this century, will be simply a by-product of the new science of conservation research. The role of the swimming pool is more valuable than yet appreciated; conservation is not the end, merely the beginning.

To spin or not to spin . . .

The prize for by-passing the slow, discontinous and difficult process of spinning and weaving textiles has never been greater. But having failed disastrously once before, knitting technologists are quietly mounting their latest challenge without any of that previous fanfare proclaiming "the comfort revolution"

Royston Millmore
is a specialist writer on textiles based in Bradford

Spinning is undoubtedly the oldest industry in the world, and the spindle whorl—a crude hand-spinning aid—is one of the oldest machines known to man. For 10 000 years or so it remained essentially the same. Then, by speeding up the spinning process and combining it with simultaneous winding on to a bobbin of the spun yarn, the whole industry was transformed by the invention of the classical spinning wheel. But even this needed four "spinsters" to keep one hand-loom weaver going with yarn, and pretty poor stuff it was, too—hence the derogatory expression "home-spun."

Power spinning changed all that, with Crompton's "mule" being perhaps the most ingenious spinning device of the lot. With a few obvious exceptions, it could spin any fibre. But the mule had a serious shortcoming: it "walked" across the spinning-room floor, first putting twist into many strands of yarn, and then had to walk back again, winding the spun yarn on to the spinning bobbins. So, after about 150 years, it was gradually pushed out by the spinning-frame that did both the twisting and the winding on process simultaneously. It is generally conceded that such machines now spin yarn slightly inferior in some respects to mule spun yarns but do it so much more quickly that they are economically superior. What had never been expected, in the worst nightmare a spinner might have, was that spinning itself would one day be considered obsolete, either for the cotton sector or the wool sector. Yet such a time occurred—and only recently.

With hardly any preliminary warning, and with little research, men's suits made of crimped continuous filament man-made fibre yarn appeared in UK retail shops at about £21 to £25 each. They seemed to be in traditional cloth designs, only finer; and they had an engaging streamlined look about them. Little detail of their technology was presented to the public, and what was not even hinted at was that they were *knitted*—or, rather, the cloth from which they were made was knitted. The vast investment of Yorkshire, Scotland and the West of England in traditional spinning and weaving machinery suddenly looked as misguided as an investment in horse-and-carriage machinery. A quiet panic ran through these regions, matched by slightly more visible rejoicing in the Midlands, home of knitting. Some West Riding worsted spinners and weavers scraped enough money together to order the necessary double-jersey knitting machines, hurriedly cleared workrooms or built new ones, and began to wait the two years or so before delivery could be made of these mechanical wonders that could "knit pound notes".



Undoubtedly the oldest industry in the world, spinning was revolutionised first by the classical spinning wheel which speeded up the spinning process and combined it simultaneously with the winding of spun yarn on to a bobbin

Reproduced from *The Penny Magazine*, 1840

Very nasty snags

Long before all the new knitting machinery was delivered, very nasty snags appeared. These were literally the pulled threads that began to hang from the new suits after only brief wear. They could be neither pulled back nor snipped off (to have snipped them off would have made holes and to pull them to the back of the fabric was beyond the capability of most people). Just as suddenly as the big, expensive advertisements for "the comfort revolution" appeared in the press, they disappeared again. For a short time it was thought that the two-way dimensional instability of the knitted fabric would be overcome and something much more like the firm fabric of the worsted or the woollen process would somehow be achieved by a refinement of the double-jersey knitting process. But nothing happened.

No doubt this drawback could have been overcome—though it is not clear how. But to have overcome it would have been to throw away a major advantage of the system. For the dimensionally unstable suit of one size had the marvellous commercial merit of fitting

several sizes of man, making off-the-peg a serious challenger of bespoke.

Equally indispensable was the crimped polyester yarn, for this was so strong that it could be rushed through the knitting machines at an unheard of speed, even when it was in so fine a yarn count that only the finest—and frailest—worsted yarn could match its appearance.

The impasse was, therefore, already considerable. There was now made a discovery that rendered it total: wearers of the knitted suits who stood in quite a gentle wind felt naked! The comfort revolution had ended in embarrassing farce, and it was back to slow old worsted or wollen spinning, and equally slow old weaving—though both these processes had been much helped latterly by a whole series of aids that had improved output considerably.

The next challenge was not long in coming, however. This was the man's suit made of filament polyester again, only this time by warp knitting—which was dimensionally stable warp-ways, and somewhat more dimensionally stable than double-jersey the other way. Moreover, it looked exactly like traditional worsted (or woollen, according to taste) even at close range. And no wonder, for it was multi-colour *printed* by paper transfer which had been most carefully constructed to match "trad" worsted or woollen. It was—and is—very clever, and deceives the eye of both wearer and viewer totally. It does not, however, deceive the body of the wearer.

Yet it would be an error to think that attempts to by-pass spinning and weaving have ended. The prize for so doing is enormous still, and the effort is, and is likely to remain, equally enormous.

Rethinking spinning

But spinning, in particular, has recently been the subject of some quite remarkable developments, involving totally new thinking in some cases. Perhaps the prize for ingenuity ought to be divided between the Czechoslovakians and the Australians. The Czechs have pioneered break spinning (or open-end spinning) and the Australians self-twist spinning. Both achieve the apparently impossible, as will emerge.

The main objection to all mechanical spinning systems of a conventional nature is that they make yarn in awkard little batches. Indeed, a spinning-frame is not a machine at all in the ordinary sense, but a battery of machines of one spindle each. As soon as the spindles are full of yarn the frame must be stopped and the bobbins "doffed" before empty ones are put in their place and spinning is restarted. End-breaks during spinning are not uncommon (especially in limit spinning) and mending these while the frame—but not the individual spindle—is in motion is quite a skill, even with all the modern aids. Moreover, spun yarn made by a frame in perfect mechanical condition is extremely delicate, since it is only a regular progression of fibres tenuously held together by friction and twist. (And the sliding friction needed in spinning has to be controlled within very precise parameters or no spinning takes place at all.)

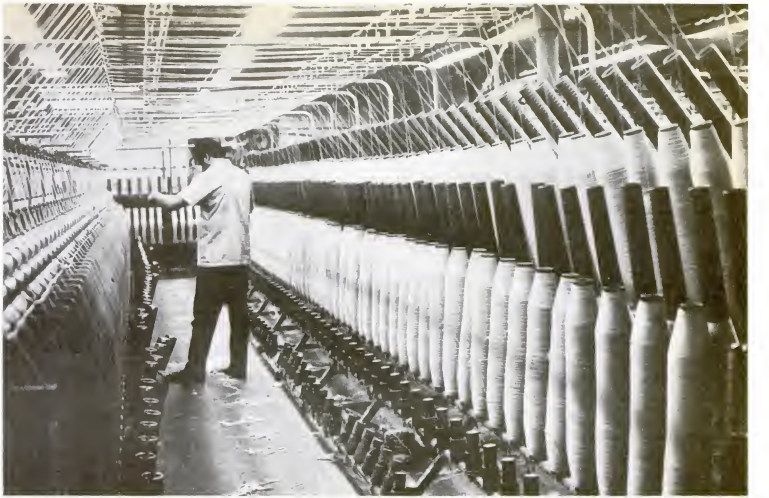
The Czech system overcomes this by completely disintegrating the incoming flow of fibres to the spinning frame (which starts in the usual form of a rope of untwisted fibres). It does this by a blast of swirling air in a small chamber, in which the fibres are instantly reassembled via a fine orifice as yarn. This is drawn off as it is made. No already-spun yarn is revolved, and the spinning is continuous.

It might well be asked why this system has not ousted all the others. The answer is that it makes a characteristic yarn that is not suitable for all purposes. Moreover, it is manifestly in trouble if the fibre supply contains any trash or slubs (thick clumps of fibre). It is not surprising, therefore, that it has made much more impact on trash-free man-made fibres than it has on natural fibres.

The Australian self-twist (also called false-twist) system has no difficulty in dealing with wool; indeed, it was developed specially for wool. It makes two yarns at once from each supply sliver, and rolls twist into them. Then, by using an ingenious dog-leg route for one of these yarns, it allows them to wrap round each other in such a way that they lock in the "false" twist that would otherwise automatically spring out the moment the rolling force was removed. This, too, is a continuous system. But it is also a maker of characteristic yarn that is suitable only for certain purposes. Obviously also it cannot make single yarn.

Recently, the Japanese have developed a new open-end spinning system that appears to overcome the tendency of the Czech system to block in the presence of trash among natural fibres. The Japanese system blows the free-floating fibres on to a perforated belt, which is then twisted into a tube, forming a yarn inside it. The yarn is extracted continuously at a point where the belt is untwisted.

The finest, smoothest, most even worsted yarn in the world is made of long-stapled marino wool on cap spinning frames. As the amount of yarn on each bobbin is only an ounce or two at best and great skill is required from the spinners, the economic disadvantages of the system are clear. Indeed, the trend of the times is doubly against fine worsted cap spinning of traditional yarn—for, in addition to the disadvantages of production in tiny batches, there is the disadvantage of using long-stapled wool on the so-called oil system. In this, the oil content of the fibres when being spun is about 3·5 per cent. Any fibre blend of which man-made fibre is a constituent cannot cope with more than $1\frac{1}{2}$ per cent oil as a fibre lubricant in worsted system spinning. So the English oil system of worsted spinning automatically disqualifies itself for the sort of high-speed, fibre-blend processing that the modern pursuit of maximum profit dictates. Against this, of course, has to be set the undoubted fact that it makes for superb cloth. It is not for nothing that the Japanese, who have the latest worsted spinning machinery in the world, the most disciplined operatives, and the finest wool to work with, nevertheless rank as the leading buyers of the best British worsted cloth. Most of this is made in Huddersfield, where outstanding cloth design is em-



Jane Bown/OBS

Still the home of the finest, smoothest and most evenly worsted yarn in the world is Yorkshire. The yarn is made from long-stapled marino wool on cap spinning frames. As the amount of wool on each bobbin is only a few ounces at best, great skill is required from the spinners and the process is relatively expensive

ployed on outstandingly good, long-stapled oil-spun worsted yarn.

It is a far cry—and probably one of pain—from such a cloth, and the suit it makes, to its latest rival in the High Street multiple-tailoring store. This is the 100 per cent man-made fibre suit made by warp knitting and transfer printing as previously described. No big attempt has yet been made to push it, however. Perhaps the reason is the nasty shock that the tailoring trade had with the double-jersey polyester suit for men. For nobody knows better than the mass tailoring trade that men's clothing is an area of nebulous aesthetics and unquantifiable preferences. It knows, all the same, that some profitable absurdities can be obtruded quite successfully on the public—such as the relatively non-absorbent towel and its almost equally hydrophobic companion, the dish-cloth that refuses to mop up anything, but which like the towel is very cheap to make. So it is too early yet to say that the stage-property suit for everyday wear will not "take". After all, jeans "guaranteed to fade" took in a big way . . .

Value for money?

Perhaps it should be said here that UK multiple tailors are not villians determined to dupe the public. They have always offered, and still offer, very good value for money to the moderately selective customer. But they are under tremendous price pressure now from the entire world, and especially from the low-wage areas which are able to export their very low price clothing to the UK with complete freedom. They know, too, that quite a lot of dumped or subsidised clothing is being sent into Britain—a lot of it made by systems that involve no spinning or weaving.

When all these considerations are put together, they result in the average ready-made man's suit in Britain tending, at least for the present, to be made of fibre-blended spun yarn (usually wool and polyester) and woven cloth. In many cases both cloth and tailoring are foreign, reasonable in price at UK retail, and by no means bad in quality. Indeed, there is a good deal of evidence that some overseas mass-production tailoring is ahead of its UK equivalent.

But many retailers have not been slow to see that, in such suits, they have a chance to impose a selling price that is not notably related to the buying price they have themselves paid. What the public rarely appreciates—and is unlikely to be told—is that a man's suit made of traditional good-weight worsted cloth, itself made by the highly skilled traditional processes, should cost only about a third more than the price of a high speed, mass manufactured imitation. But, then, it is in very few people's interest that this should be known: very few, that is, if you exclude all the sheep farmers of the world and, of course, all members of the general public.

Collagen—the universal body builder

Collagen is the most important supportive component of all animal life. A growing knowledge of its molecular organisation is providing new insights of its structure and function, and their relationship to animal development, ageing and disease processes

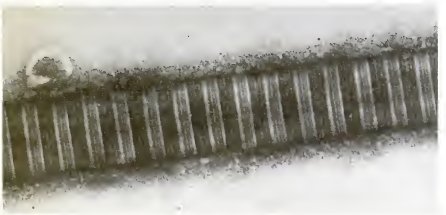
John Woodhead-Galloway
is Sir Henly Royce research fellow in rheumatology at the University of Manchester. Until recently he worked in the Molecular Biophysics Laboratory, University of Oxford

An understanding of the molecular structure of collagen could well provide us with the structural key to how multi-cellular animals evolved from single-celled ones. Of even more immediate importance, it could throw new light on some of the ageing processes that are seen to affect all life forms. Probably all animals have some collagen. Certainly it is massively present in vertebrates where it is the chief protein of bone, cartilage, and connective tissue. Recently it has been recognised in a wide range of invertebrates. In man, failure of the collagen in various ways is associated with painful and crippling diseases, and there is a clear correlation between changes in collagen and ageing, when bones weaken and skin becomes wrinkled and thin.

Collagen plays an important part in the healing of wounds and in the early development of an animal. Its function, once an animal is mature, is very much a structural one. It fulfils this through a distinctive molecule, the constituent amino acids of which are arranged in an astonishingly regular sequence. The molecules aggregate in a highly orderly way and then, through the formation of strong chemical bonds, known as covalent cross-links, between the molecules, form very tough, stable fibres. Only in recent years have we come to an understanding of the relationship between the amino acid sequence and the formation of the fibres. The revelations that emerge promise to be as exciting as, if not more than, those emanating from our understanding of the structure of DNA.

The collagen molecule then, is the building block of all connective tissue. Around 1955, as a result of X-ray diffraction work by Tony North and colleagues at King's College, London (see for example *Nature and Structure of Collagen*, edited by J. T. Randall, Butterworths), and of model building by Alex Rich and Francis Crick in Cambridge, and G. N. Ramachandran and his colleagues in India, it became clear that the molecule consists of three, probably similar, chains of amino acids wound together in a triple helix. Later, in the mid-1960s, at the National Institute of Dental Research, Maryland, Karl Piez, among others, confirmed biochemically that the free molecule is composed of the three chains—usually two of them being identical. Other work has shown that the molecule is 3000 angstrom long and 14 angstrom in diameter—a shape that is well suited to fibre making.

Figure 2 Electron micrograph of negatively stained collagen fibrils showing transverse banding with period of 680 angstrom



The basic sequence

Stereo-chemical considerations provided the final clue to the molecular structure hinted at by X-ray diffraction. They indicated that the close-packing of three chains to give a stable structure required that every third amino acid in each chain be glycine—the smallest of the amino acids—a point inferred at least in part from the amino acid composition since glycine was present as about one third of all amino acids. This predicted regularity was confirmed finally in 1972 when the amino acid sequence of a chain was determined. Figure 1 shows part of the sequence and clearly reveals the regular occurrence of glycine. Another feature is the presence of a lot of alanine, and even more of the so-called imino acids proline and hydroxyproline. Hydroxyproline is not coded for by DNA but is a modification of proline that occurs after the amino acid sequence has been formed. The

Figure 1

- Gly - Ala - Hyp - Gly - Pro - Hyp - Gly - Ala - Hyp
- Gly - Ala - Hyp - Gly - Pro - Val - Gly - Pro - Ala - Gly
- Lys - Ser - Gly - Asp - Arg - Gly - Glu - Thr - Gly - Pro
- Ala - Gly - Pro - Ile

Key

Abbreviation	Amino acid	Character	Purpose
Gly	Glycine	—	triple helix former
Ala	Alanine	—	"
Pro	Proline	—	"
Hyp	Hydroxyproline	—	"
Val	Valine	hydrophobic	self-assembly through the 234 amino acid stagger
Ile	Isoleucine	"	"
Arg	Arginine	positively charged	"
Asp	Aspartic Acid	negatively charged	"
Glu	Glutamic Acid	"	"
Lys	Lysine	positively charged	self-assembly through the 234 amino acid stagger and may take part in a strong covalent cross-link
Ser	Serine	—	—
Thr	Threonine	—	—

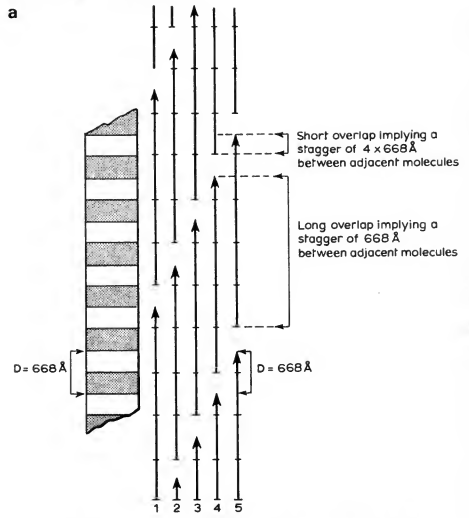


Figure 3 Scheme for the arrangement of collagen molecules in the fibril giving rise to the alternation of regions having more and less protein in them. A minimum number of five strands is needed to generate the periodic structure

conversion of proline to hydroxyproline needs vitamin C, and in scurvy, the best known of the conditions resulting from a lack of vitamin C, the prevailing symptom is connective tissue failure as a direct result of the inadequate conversion of proline to hydroxyproline.

The four main amino and imino acids make up about 70 per cent of the total number of amino acids in the collagen molecule. This observation has given rise to speculation that there is a relationship between them and the triple helix. A number of artificial polymers containing glycine in every third position may be made, and W. Traub at the Weizman Institute has synthesised combinations of the other three in the other positions. X-ray diffraction experiments on these polymers reveal that the molecules are triple helices just like collagen, thus substantiating the idea that the molecular structure is dictated by these amino acids.

But what about the other 30 per cent of amino acids in the molecule? There are about 1000 amino acids in a single chain, so there are about 900 amino acids in a molecule of three chains which are not directly implicated in its structure. The answer lies in the fact that collagen fibres are orderly arrangements of molecules. It is not sufficient that the molecule is a good individual unit for forming fibres: as building material it must assemble with other molecules in an orderly way.

The molecules aggregate giving what are known as fibrils—small fibres some hundreds, or perhaps a few thousand angstroms across. Collagen always seems to be present in tissue as fibrils. The tissue is then built up of such fibrils, either as networks or as bundles, with varying degrees of order. In skin, for example, the fibrils are relatively disorderly in their arrangement, whereas in the fibrous cornea of the eyeball they are very orderly.

How are the molecules arranged into fibres? Figure 2 is an electron micrograph of a fibril of collagen from a tendon taken from a rat's tail. The fibril has been negatively stained with ammonium molybdate, which is a strong scatterer of electrons and thus gives good contrast in the electron microscope. Most striking is the regular alternation of heavily stained regions and unstained ones.

Advantages of an orderly aggregation

The period of alternation is 670 angstrom—far shorter than the molecular length. In fact the molecule's length (3000 angstrom) is almost five times the period. An interpretation of all this was suggested by J. A. Hodge and A. J. Petruska (see *Aspects of Protein Structure*, edited by G. N. Ramachandran, Academic Press), basing it on an idea by J. Gross and F. O. Schmitt. Figure 3a, although only a two-dimensional interpretation of what is a three-dimensional structure, conveys the essence of how the molecules are arranged in a fibril. Each molecule is staggered with respect to its neighbours by 668 angstrom. Accurate measurements of this distance, using X-ray diffraction, which has also allowed us to determine the average separation of amino acids along the molecule, tells us that the relative stagger is 234 ± 3 amino acids.

What advantage is there in such an orderly aggregation of molecules? I said earlier that collagen's strength and stability reside in the strong chemical cross-links between the molecules which stitch the fibres together. Each cross-link involves two chemically modified amino acids, lysines, each modified lysine contributing half the bond. The most obvious reason for the orderly assembly of collagen is that the cross-linking takes place between certain lysines only and that these must be brought close together for the bond to form. This is almost certainly the correct explanation, since it is extremely difficult to persuade the cross-links to form between molecules in solution, but very much easier in the assembled fibril.

We are now in a position to return to the amino acid sequence and the part played by the amino acids that are not implicated directly in triple helix formation. The guess is that these are responsible for the mutual stagger relationships adopted by the molecules in the fibre, ie these confer upon the molecules the potential for the specific self-assembly of the fibril. How do these specify the stagger?

Each amino acid has a side chain. For example, while the side chain of glycine is a

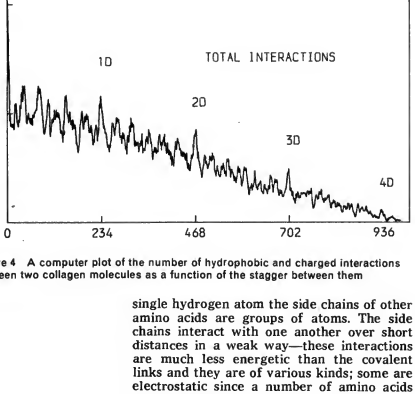


Figure 4 A computer plot of the number of hydrophobic and charged interactions between two collagen molecules as a function of the stagger between them

single hydrogen atom the side chains of other amino acids are groups of atoms. The side chains interact with one another over short distances in a weak way—these interactions are much less energetic than the covalent links and they are of various kinds; some are electrostatic since a number of amino acids have charged side chains. Arginine, for example, has a positive charge, whereas glutamic acid is negatively charged. Thus, an electrostatic bond may form between an arginine and a glutamic acid. Other side chains, such as those of valine or isoleucine, are not charged, but may still form a weak bond because of an energetic aversion for the surrounding water. Such bonds are termed hydrophobic. (A well known example of the effect is the clustering into droplets of oil dispersed in water.) The side chain interactions are individually weak but there are a lot of side chains in the molecules. If two collagen molecules are close together and with a relatively large number of weak bonds between them, then the molecules will tend to stay in that relationship. If the relationship is such as to allow cross-linking, then, given time, the links will form. Thus, the question is—does the stagger relationship of 234 amino acids maximise the number of weak bonds forming between the side chains of one molecule with those of the other? Recently in Oxford we examined the sequence and found that the interactions are maximised at a relative stagger of 234 amino acids (*Journal of Molecular Biology*, vol 79, p 137).

Instructions for other 3D structures

What we did was to run the sequence past itself, using a computer, and count the number of possible electrostatic bonds and hydrophobic bonds formed for all possible relative staggers of the two sequences. Figure 4 shows the results of the analysis. There are quite pronounced peaks at staggers of integral multiples of 234 amino acids. There are other peaks too, though, and these seem to be related to the other structures that collagen forms under conditions different from physiological ones.

This is the first of two articles on the molecular organisation of body structural components. In the next, David Hukins considers the role of mucopolysaccharides as extracellular shock absorbers

Thus, a picture emerges of the way in which the amino acid seqüence implies the structure of the fibril. The relationship between amino acid sequence and structure is one of the central problems of structural molecular biology—it has long been recognised that the amino acid sequence of a protein is itself the set of instructions for the formation of the three dimensional structure of a molecule, and for the assembly of the molecules to form tissue. The amino acid sequence is the thing that is coded for by the DNA, but the sequence itself has no biological function. It is only when the linear chain of amino acids has folded to give a specific molecular structure, and, as in the case of collagen when the molecule has come together with other molecules, that it is useful to the animal.

Until now, there has not been much success in solving the problem of the relationship between sequence and structure. It is pleasant to find, however, that here at least the answer is a simple one.

The linking of amino acid sequence to molecular structure is one step in unravelling the threads of the way information is passed down from the genes to give the complete individual animal. The problem is one of recognition. At one and the most important level, cells recognise individual amino acids and thence build protein chains with specific sequences. At another level, the molecules formed recognise one another and, for example, collagen fibrils spontaneously assemble from the collagen molecules. At the next level, connective tissue forms from the fibrils and other components. For example, bone matrix is a mixture of fibrils and the mineral apatite (calcium phosphate). Cartilage matrix is a network of fibrils and polysaccharides. Not a lot is known about the way cartilage forms but in the next paper in this series, Dr D. W. L. Hukins will be describing the polysaccharides and the way that they interact with the fibrils. He will explain how these different kinds of molecule recognise one another and how they mutually influence their organisation.

A detailed knowledge of the molecular structure of a tissue like cartilage is not merely of academic importance. Cartilage, like other kinds of connective tissue, changes with age and one of the unpleasant manifestations of this is that people develop osteo-arthrosis (the new name for what used to be called osteo-arthritis). Since the majority of people develop it some time and suffer from joints which no longer do their job properly, the problem of what happens as cartilage ages is very relevant. Of course even if we did understand what is going on that does not mean that we could do anything to influence it to our advantage—but we just might with more knowledge.

What seems to be emerging from research into osteo-arthrosis is that there is large-scale molecular reorganisation of the collagen within the tissue. We don't, as yet, know the details, but if the problem is susceptible to the kinds of approach that have led to an understanding of the structure at a simple level then we should soon.

The last thing you want to bother about at college is opening a bank account.



When you get to college or university you'll have a lot to organise. A lot to do. A lot to see. So it makes sense to sort out your finances before you get there.

The NatWest Student Service does just that.

Just post the coupon (you don't need a stamp) or take it to your local NatWest branch and the NatWest Student Service will do the rest.

Your account will be waiting for you, close by your college, in exchange for two signatures and your grant cheque.

And then you'll get:

1. A cheque book (a special student or pictorial one if you like).

2. Regular statements, to keep tabs on your money.

3. Advice on your money problems.

Your account is free while you're a student, as long as you stay out of the red. You could even get a Cashcard, which enables you to get £10 cash, day or night, from any of our 400 Cash Dispensers.

You can do it now.

To: National Westminster Bank Limited, FREEPOST Student Service, 41 Lothbury, London, EC2B 2GN

Name _____ Age _____

College _____

College address _____

Course _____ Start date _____

Home address _____

Tick here for special student cheques ☐

Special pictorial cheques ☐ Your signature _____ NS

As soon as we receive this coupon, we will get in touch with the nearest branch to your college.

NatWest

Technology review

'Dial-anywhere' network arrives

Seventeen years after the Queen hesitantingly dialled the first STD telephone call, the end is in sight for Post Office efforts to fully automate long distance telephoning.

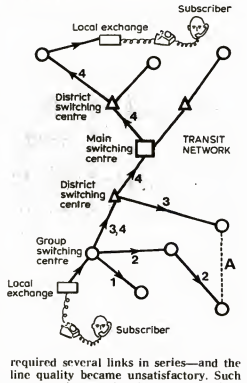
During the next three months, London will be tied into a completely new "Trunk Transit" system linking all British exchanges. By Christmas, London subscribers will be able to dial 700 more exchanges than now, giving them automatic access to virtually every telephone in Britain. Fully automatic service will be extended to the whole UK by 1978.

Trunk Transit was installed over the last five years to bypass the old operator dialled long distance trunk network. It involves special high quality lines, a fast signalling system based on six frequencies instead of one, and a more sophisticated switching system to route calls through the network.

The first steps to automate trunk calls began in Bristol in 1958 with a register and translator system based on group switching centres (GSC). There are about 300 GSCs in Britain, which control all trunk traffic for a group of 10 to 20 exchanges. When a subscriber dials a call, it is identified as STD by its initial zero and routed through the local exchange to the GSC. There, a register stores the dialled number while a translator converts the STD code to a trunk network route. The translator then drops out of the circuit and the call is routed to the next GSC (1 in the diagram) and to the wanted number.

But translators have limitations, particularly in their memory capacity. Early electromechanical translators had a limit of 300 possible codes. There are 700 basic three-digit STD codes in use—but more translations are often required for special purposes. Later designs for the six large conurbations, including London, had magnetic drum storage which held up to 1000 codes. But these ran up against another limitation which blocked nationwide STD until Trunk Transit was developed.

Many of the more distant connections



required several links in series—and the line quality became unsatisfactory. Such a connection would also have required the translator to output a longer trunk code than it could store.

Thus, although very wide STD coverage was achieved by the early 1970s, there were gaps—and irritating variations in coverage of a particular area in different parts of the country. Coverage from any GSC was limited to GSCs that could be reached on two links in series (2 in the diagram). Even if a third link could connect a more distant exchange (link A), this would not be used because of poor transmission quality.

It was apparent very early that a back-up system would be needed to complete coverage—especially of small or remote sites. Three wholly new features were necessary to provide the backup system; a switching system which was fast, efficient, and allowed for alternative routes; a fast signalling system because of the number of links necessary; and high performance transmission to maintain call quality.

Trunk Transit is based on nine Main Switching Centres (MSC) and 29 District Switching Centres (DSC). The TXK4 crossbar system was chosen as standard equipment for MSCs and DSCs in 1966. Although crossbar was then new to the PO network, the already developed TXK4 system seemed attractive. Crossbar switches use interlacing rods to operate contacts, and are generally more efficient and less noisy than the predominant Strowger rotary switches.

A new multi-frequency signalling system, MF2, was developed to allow fast signalling between registers at GSCs and appropriate transit centres. The new system, developed to a European standard, uses two frequency combinations sent in 1/10th of a second to indicate any digit. The entire information on any link takes $1^1/_2$ seconds to send—compared with about nine seconds of normal STD signalling. The previous system, AC9, merely converts DC pulses from the telephone dial to pulses of a single frequency sent at the same slow rate.

The third essential component of the new system is a high quality trunk network. Difficulties were encountered by operators on manual multi-link calls, particularly high attenuation and wrong numbers through bad transmission. To combat this, low-loss four wire circuits are used throughout, as opposed to the two-wire type, where signals in both directions are sent on the same pair of wires. The removal of "balancing" difficulties between two directions made possible lower losses in four-wire switching and transmission. Crossbar switching also reduces the amount of exchange electrical noise. Together, these developments provide a much improved service. A Transit call is readily identifiable by fast connection and a very clear line.

Construction of MSC and DSC exchanges started about 1970, and all but two are now fully operational. The network which links them is a key feature of Transit. The MSCs are the highest network level, and are "fully interconnected"—there must always be lines available from one MSC to any other.

The diagram shows how the Transit network (shaded) backs up the STD system. Call 3 is now possible using Transit where no STD was previously acceptable. Call 4 shows Transit fully used with four trunk links to carry the call between two GSCs, and between the two callers.

Not shown on the diagram is one of the most novel features—a facility for fast automatic rerouting if busy routes are found. DSCs and GSC Trunk Transit equipment have provision for selecting up to four different paths if any route is busy. Considerable savings in trunk line costs can result from the more flexible network use. High usage groups of lines are installed where all circuits are often in use, while other calls overflow onto other routes. As a result of rerouting facilities, more traffic can be carried on a network of given size.

Between now and 1978, the finishing touches will be put to Transit. In London, this involves connections from central STD switching units to London MSC. In the provinces, many GSCs have to be provided with their access equipment for Transit.

The advent of Transit will make more difference to subscribers on a small provincial GSC than to London subscribers. Present limitations of register-translator equipment and the restricted range of trunk circuits available give provincial exchanges poor STD coverage. When their access to Transit is switched on, they will suddenly have access to all British exchanges, as well as the very extensive international subscriber dialling facilities which are also connected through the Transit centres. "That", said a Post Office spokesman, "is what we call the dial-anywhere network".

Duncan Campbell

Chrysler has been fined over $300 000 by the Californian Air Resources Board for selling cars which do not meet the state's air pollution controls. The fine covers more than 6500 of the 1975 model cars, and was paid "under protest" after the board warned Chrysler that it could not sell high-powered 1976 model cars until the fine had been discharged.

The fine was, according to Tom Quinn, chairman of the Air Resources Board, for "continuing and massive violations of California's anti-smog laws". The 1975 models involved were Chrysler, Dodge, and Plymouth cars with 7200 cu. cm engines.

Quinn said that Chrysler is likely to challenge the fine in the courts, but also said: "I sense a new commitment on the company's part to build clean cars".

Philips kills Unidata as Siemens goes it alone

The dissolution of Unidata (the continental European challenger for the bronze medal in data processing) is as stiff with mysterious rumours as was its creation (see also p 570).

The three elements of Unidata were Siemens, Philips and CII (the French Compagnie Internationale pour l'Informatique). The French government recently gave in to economic pressures and arranged that Honeywell-Bull would provide the machine range for CII to market and that only special communication machines would carry the CII all-French label. The disguise adopted for the US leadership behind Honeywell-Bull was that French interests would hold majority voting control of the merged firm. Whether this voting control would operate other than a veto on employment reductions in French plants is an open question, but the day-to-day running style of the HB-CII entity was certainly all Honeywell.

So it seemed three months ago that CII had withdrawn from Unidata—except for supplying machines which were committed by the schedule of deliveries. But contrary to this idea of CII aloofness, after the formation of HB-CII the French staff became more informative and helpful at product development meetings in Unidata. The French appeared to be asking to be told to leave, by the simple expedient of generating an extrovert interest in the plans of Unidata for the future.

But now the pressure of funding has hit Philips' participation in Unidata. Redundancies in Philips' Netherlands plants are thought to be large, perhaps up to 2500 jobs. Philips is, however, persisting in the small business computer market where it has had real successes for some years now.

When Philips asked to join Unidata, CII-Siemens arrangements for collaboration were far advanced. Philips' admission ticket to the consortium seemed to be its grip on the small business machine's potential. Unfortunately, in France the government was already betrothed to Logabax, a French firm with long experience in accounting machinery and primative computers. Logabax has recently done very well with a fast but cheap printer for computer terminals, still has some success in small business computers as complete systems, and is still very French. So Philips had to back its entry ticket with a "bribe"—generally thought to be agreement to carry a large share of the long-term Unidata software costs.

But the truth was less kind. Siemens had machines destined for the early version of the Unidata range. But these needed additional software which Philips agreed to fund. So Philips found it was pushing Siemens elements in the Unidata product line.

As funds became scarce, the all-Unidata products of the future had to be trimmed and shelved. With Philips and CII both out, Siemens says it will go it alone in the large computer market. This contradicts all that was said two years ago when Unidata was set up. Then the emphasis was on the absurdity of a solo funding for computer range development. Univac must be the natural partner of Siemens and its executives must be flying every kite available.

Both Philips and Siemens have been sizing up the general office market for electronics products. Philips is already entrenched in this market with dictating machines and telephone systems. It sees that small computers can be merged with automatic typewriter products to support a dynamic market.

Meanwhile in the US the top executives of Xerox were assessing its position in the office products field and deciding to push-ahead with new electronics-based products for the general office market, but to save cash by stopping new product development in the bigger data processing field.

The same data must be available to the senior counsels of Xerox, Philips, and Siemens. The market studies show that larger computers sell into a market where allegiances are relatively fixed. Saturation is not near in terms of yearly sales value, but in terms of new growth from organisations without an existing base load in computing, this market is over 75 per cent soaked.

But the use of electronics to aid text production and information flows in office work is destined to boom. The office worker is now costly and yet still proliferating. The use of new private telephone exchanges plus cheaper automated letter and report production is an appealing combination to many office executives. Slotting some local data processing on to the back of these changes is an easy task for the new small computer designs.

So who needs to waste cash on fighting for a share of the cake that IBM made and is now visibly divorcing from its growing range of products in general office systems? Philips and Xerox have obviously decided not to.

Hedley Vousey

US subsidised British and European satellite launches

The US subsidised the cost of launching satellites for the UK Ministry of Defence (MoD) and for the former European Space Research Organisation, despite claims by the US military and NASA that it was charging full costs, according to a US General Accounting Office (GAO).

The GAO suggests that the undercharging may have been intended to encourage foreign countries to use US satellite facilities. The US not only launched the satellites, but in some cases built them and provided tracking facilities as well.

The undercharging was substantial—an average of $1 million each for the ESRO Heos A2 and TD/1A in 1972 and $3·4 million each on the MoD Skynet A and B launched in 1969 and 1970.

In practice, the UK Skynet programme has done none too well with the US. The first satellite, built by a US firm, Philco-Ford, ceased functioning after only two years. Its intended life was five years. The second and third satellites, launched in August 1970 and January 1974, failed to get into orbit. Only the fourth one, built by a British firm and launched in November, actually got into orbit and worked (see *New Scientist*, vol 64, p 652).

The underbilling came, according to the GAO, from a failure to charge for indirect costs of management and operation of the launch centres. Based on the GAO report, NASA and the US military will now charge more, but GAO complains that the US will still be subsidising foreign satellite launches.

The GAO is the US government's fiscal watchdog. It has 5400 employees and a budget of nearly $140 million. Most of its reports are done for the US Congress, and except for those on secret weapons systems, all reports are public.

A survey by *Aviation Week* (1 September) showed that GAO reports are having an increasing impact as the money squeeze forces the US Congress to take a closer look at programmes.

The GAO does not look just at the spending and whether finished projects fulfil requirements, but also at the more controversial area of the requirements themselves.

SCIENTIFIC CALCULATORS

CBM 4148 R

Fantastic 48 key 14 digit scientific notation calculator with 2 memories, logic, trig log, arc, sin, cos and tan functions as well as thirty others. This rechargeable calculator will be invaluable to scientists, engineers and students

£36·95

Plus FREE MAINS ADAPTOR worth £2·95

SINCLAIR OXFORD 300 This scientific calc has four basic arithmetic functions, full 5 function mem. auto constant square root, Pi, logs, sin, arcsine, cosine & arccosine, Tan & arctan operating in exchangeable degrees or radians Battery/mains

£22·95

TEXAS SR50

Rechargeable scientific 41 key calc, featuring : sine, cosine tangent Inverse trigonometry, hyberbolic functions, angle change, common & natural logs, e to xth, y to the xth, xth root of y, exchange x and y. Memory. Battery charger included.

£43·95

CAVENDISH SALES CASSETTE CENTRE

279/283 WHITECHAPEL RD E1 VAT-add 8%

NEXT TO WHITECHAPEL UNDERGROUND. Tel: 01 247 3453

Taking LED out of petrol

Sunlight is delaying the all-electronic petrol pump. Ferranti's Rotating Components group has been evaluating such an electronic petrol pump at an Esso garage near Edinburgh but all is not well.

Basically the Ferranti system is electronic from the time that the flowmeter in the pump records how much petrol is delivered through the pump. The output of the flowmeter is the rotation of a shaft. Ferranti uses an optical encoder to digitise this rotation. Digital displays then show the amount of petrol delivered, as well as price, grade, and total sales value. The trouble is that the displays are practically invisible when strong morning or evening sunlight falls on them. Ferranti proposes electromechanical displays to overcome the problem but the reliability of the whole system will suffer a shattering blow.

Garages opting for the system can choose between independent units for each pump or, for self-service stations, a console displaying data from all pumps.

Apart from the greater reliability of electronics as opposed to mechanical or electromechanical devices, the improved accuracy of measurement means a refinement for the garage owner which may work marginally against the consumer. Weights and measures inspectors are vigilant, so petrol measures have to be a trifle generous, as must be the rating



of blends in a blending pump. The optical encoders cut the cake closer to the owner's interests, without infringing customers' rights, but curbing the generosity of existing apparatus.

All these benefits are, however, counterbalanced by not being able to read the display from light emitting diodes or other electronic filament display units designed for laboratory or plant environments rather than the great outdoors. There is some hope that reflective displays will cure the problem, but for the moment only electromechanical units are readable in strong sunlight.

Boots boosts child resistant packs

Boots the Chemists is now dispensing a wide range of prescription drugs in child resistant packages. The bottles have a United Glass Clic-Loc cap, which requires the user to press down and turn at the same time—an almost impossible degree of coordination for small children. Boots also supplies instruction leaflets with the bottles, and is paying 0·2p per cap more than for ordinary caps, according to George McHardy Smith, Marketing Manager of United Glass Closures and Plastics. Boots has already ordered several million caps, he said. Another firm to order several million Clic-Loc caps is the Dutch firm KNS, which is packing bleach, white spirit, and ammonia in child resistant containers. In Britain, Johnson Wax uses child resistant closures on two furniture polishes, and Squibb uses them on a pre-packed prescription tranquiliser, Motival.

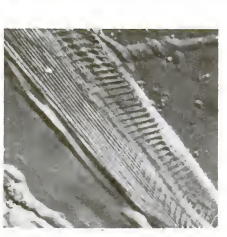


A new edge to light microscopes

How can one obtain clear photomicrographs of unstained materials with striking three-dimensional effects without a scanning electron microscope? The answer: spend about £100 upgrading an ordinary light microscope. The innovators responsible for this development are Robert Hoffman and Leo Gross of the Waldemar Medical Research Foundation in New York. They reported it at last month's International Biophysics Conference in Copenhagen, and in the May issue of *Applied Optics* (p 1169).



To achieve these results a special aperture is placed between the light source and the condenser of the microscope, and a plate with three distinct areas of different transmittance is placed between the eyepiece and the objective. The plate has a clear region and one which absorbs most of the light, situated on either side of a region through which transmitted light is reduced in intensity so that it appears grey. The net effect of these components on the image is that all boundaries or gradients on the specimen appear light or dark because light passing through these areas is directed to the eyepiece through the transparent or dark region on the plate. All flat regions on the specimen will appear grey.



Modulation contrast microscope view of muscle tissue.

Thus the image is produced by light intensity modulations above and below an average grey level—hence the name modulation contrast microscopy. In a sense the objects are rendered visible by artificially producing a shadow pattern. This is analogous with the common experience that ripple patterns on sand are difficult to see when the sun is overhead, but easy to see when the sun is low. The system also illustrates a trend in imaging towards the use of edge effects, rather than transmittance or reflection.

The modulation contrast system renders objects which are invisible under bright field microscopy just as visible as with phase contrast, with the advantage that the phase "halo" is removed. The limitations on working distance, magnification, and resolution normally associated with phase contrast are also removed. The system has the advantage of a fine plan of focus, wide observation field and a 3-D effect in the image.

Hoffman and Gross have established a company—Modulation Optics—to equip ordinary microscopes with the aperture and modulation plate, so as to make the system available to scientists as soon as possible.

Love of IBM based on ignorance

"Questionable procedures" in acquiring new computer equipment, including a myopic preference for IBM and failure to protect against potential conflict of interest, are attacked in a consultants' report on the computer policy of the US state of Connecticut. The report shows that local authorities' tendency to opt for IBM when they have little computer knowledge extends to the US, too (see *New Scientist*, vol 67, p 213).

The consultants looked at the state's leasing of a pair of IBM 370/168s. They noted that one machine would cost only $4·3 million to buy but will cost $6·8 million over the life of the contract to lease; the lessor takes no responsibility for the quality of performance of the equipment; and the state must even pay to ship the computer back after the lease runs out, according to *Computerworld* (3 September).

Suggesting that the state not even lease the second machine, the consultants also made a long series of other comments. In particular, they suggested the state increase the number of trained computer people in on leasing decisions and that the state put leases out to tender as they do with purchases.

Finally, the consultants recommended that to protect against conflict of interest, officials involved in procurement decisions be asked to disclose interests such as stockholdings in suppliers.

The consultants also looked at general state computer practice, and urged more effort to avoid such "common pitfalls" as "using on-line systems where batch procesing would do as well" and "buying systems which convert hard copy into computer language and retrieve it as hard copy and where marginal increases in response time are being obtained at horrendous marginal costs."

Soviets blow gravel—and people—through pipelines



This compressed air pipeline is being tested at Ramenskoye just outside Moscow. It is part of the trials for a pneumatic goods line which will carry gravel from a quarry to the site of an ore-dressing works near Klin, some 80 km north of Moscow. The seven kilometre long pipeline will use a "train" with six containers, and its designers estimate it will be able to carry 20 million tons of gravel a year.

This is not the first such pipeline in the Soviet Union. A smaller one, 2·2 km long and one metre in diameter, has been operating successfully in Shulaveri, Georgia, for some years carrying sand and aggregate to building sites.

The bulk of design work on pneumatic pipelines appears to take place in the Transneftautomatika design bureau of the Glavneftesnab in Moscow. In interviews given to the Soviet press over the past few years, the chief engineer of the bureau, A. M. Alexandrov, has mentioned a number of projects that the bureau is working on—for example, the transportation of refuse and household wastes to a processing site in Leningrad, or of sand to a silicate plant in Volgograd. In both cases the distance to be covered is some 12 km. Alexandrov has also mentioned plans for the second stage of the Georgian line. This ambitious project envisages a 45 km long double track to carry sand and aggregate from the Shulaveri quarry to Tbilisi.

The bureau has also drawn up designs for a passenger pneumatic train service in Zelenograd. According to the designers the project does not involve any particular technical problems and its realisation should be just a matter of time—and presumably money.

Energy, space, and defence, will gain in 1976 US spending

US government spending on R & D will increase by some $2700 million in 1976, compared with an average annual decline of 2·7 per cent between 1969 and 1975. According to a National Science Foundation report (An Analysis of Federal R & D Funding by Function, Fiscal Years 1969-76), energy, space, and defence research will benefit most from this increase. And the $2700 million lift is so great (bigger than in any other year in the period) that it will probably mean a rise in real money values.

The report, based on the President's budget message to Congress, says that health research is the only area that will take a cut—$255 million—even before inflation. Overall, R & D spending will rise to $21 700 million. Defence R & D will get another $1860 million and energy and space $343 million each.

Defence will remain the biggest consumer of government R & D funds, swallowing 52·5 per cent of the total. The proportion of funding taken by space will have dropped from 23·9 per cent in 1969 to about 13 in 1976.

But by far the fastest growing area of government funded R & D is energy. In 1969 it accounted for only 2 per cent of R & D funds. By 1976 this will have doubled to reach 5·9 per cent. By far the biggest jump is in the area of geothermal, solar, and advanced systems.

Irish airline toilets are safer

Aer Lingus passengers will no doubt be reassured to hear that the Gaelic airline is installing "potty bottles" in the toilets of its Boeing 737s. No emergency WCs these, but sophisticated fire extinguishers that douse any fire in the toilet litter bin within 15 seconds.

The potty bottle, looking for all the world like a cartoonist's bomb, sits above the litter bin. It contains 120 grammes of Freon. If the temperature in the litter bin reaches 80°C, the bottle discharges, killing any fire. The development of the $35 gadget follows several fires in the toilets of Boeing 727s and 707s last summer. The fires were controlled by hand extinguishers, but the US National Transportation Safety Board recommended mandatory automatic extinguishers.



CHLORIDE LORIVAL

Lorival Depolymerised rubbers and their vulcanisable compounds are at present aiding the fight against cancer, helping production of vital heavy chemicals, sealing high rise buildings and protecting electrical and telephone joints underground. If you are interested in our materials for industrial applications write, telephone or telex

Chloride Lorival Limited Little Lever Bolton BL3 1AR
Telephone: 02 04 72155 Telex: 63228

A member of the **CHLORIDE** group of companies.

Engineering a solution

Just one month after the Council of Engineering Institutions made, in its own words, a "breakthrough" in reorganising itself, its second largest member—the Institution of Electrical Engineers—has given notice that it intends to quit. Why are the engineering institutions tearing themselves apart?

Lawrence McGinty

A guest at a dinner party was asked how he kept the wolf from the door. When he replied "Oh, I'm an engineer", his fellow guest demanded "Well what do you think of Hugh Scanlon's policies?"

This probably apocryphal anecdote illustrates perfectly why the engineering profession is, almost for the first time, publicly baring its innermost soul. In 1963, some 13 engineering institutions founded what is now the Council of Engineering Institutions (CEI) to give their profession a cohesive and powerful voice in public affairs. Today, many engineers believe that the CEI has signally failed to raise the engineer in public esteem, and has not even been able to handle promptly and efficiently the internal machinery of the profession. Indeed, the CEI admits that the majority of engineers know little of its work.

The idea of a professional engineer, as opposed to Hugh Scanlon's members, has not been established in the public mind. A doctor is a doctor. But many well-informed people still think of an engineer as a man with a spanner in his blue denims. Blame for this sad state of affairs is laid firmly at the feet of the CEI, perhaps not a little unfairly. Last August, the presidents of the three largest member institutions—the civils, mechanicals, and electricals—decided that the CEI has outlived its usefulness and proposed that it be transformed into an Institution of Engineers.

They located the cause of the CEI's troubles in its federal structure. The CEI board consists of three officers from each of its 15 member institutions, resulting in 15 back-seat drivers—the councils of the individual institutions, which delegate their representatives. The failings of this structure are very obvious. Significant decisions are years in the making and, when they arrive, "are in the nature of a highest common factor that is often deplorably low", to use the words of A. G. Milne, a past president of the electricals.

Take just one issue. Theoretically, the CEI is responsible for awarding the designation "chartered engineer". In practice, individual institutions still have almost total control over which of their members become chartered engineers, since all chartered engineers have to be corporate members of institutions. This has two effects. First, there are anomalies, gross according to some, between the qualifications of chartered engineers in different institutions. It took the CEI many years to decide that all chartered engineers must be graduates (or hold equivalent qualifications). But some chartered engineers, because their institutions demand more than the CEI minimum for corporate membership, are honours graduates; whereas others, in less demanding institutions, have only ordinary degrees.

With Britain's accession to the Treaty of Rome, this issue assumes a significance much greater than ever before. To prevent discrimination against foreigners, the Treaty demands that the EEC Commission issue directives detailing the equivalence of professional qualifications throughout member states. The Department of Industry asked for comments on how this could be achieved for engineers by December 1974. The CEI managed a reply only this summer, recommending that all chartered engineers be equated with professional engineers in continental Europe. One senior institution official describes this as "ludicrous", since the qualifications of some chartered engineers are "abysmally low". At least one institution will dissociate itself from the CEI recommendation.

Revamping the CEI

To overcome the CEI's deficiencies, the three presidents suggested a new structure based on individual membership. Engineers would join the revamped CEI, not individual institutions, although existing institutions would still provide the learned society services —symposia and so on. All engineers would elect, regardless of disciplinary boundaries, a small council which would be responsible for qualifying engineers, enforcing rules of professional conduct, and representing "the profession as a whole".

The proposals split the 15 members of the CEI right down the middle. On the one hand, the big three—civils, mechanicals, and electricals—plus chemicals, structural and gas engineers (the six) backed the idea that the CEI must change. The remaining nine were broadly satisfied with the status quo. However, the six were in a classic Catch 22 position; although they represented more than 60 per cent of CEI's members, the CEI's federal structure meant they were certain to be out-voted.

After much discussion in the institutions and, more significantly, after extensive lobbying behind closed doors, a CEI working party arrived at a compromise. The really revolutionary change that would have emerged from this idea is that the CEI's board would have, in addition to 15 members nominated by member institutions, 15 members elected by all engineers as individual members. The stranglehold of institutions representing a minority of members would be broken.

In preparation for the CEI board meeting that would decide on these proposals, the six met and agreed that further compromise would dilute the principle of their original intent to such a degree that the issue would have been lost. But the board meeting, last July, held some surprises. Only the electricals stood by the basic idea that the federalism of the CEI had to be obliterated. The nine agreed that individuals should be able to hold membership of CEI and that members of institutions should elect representatives to the CEI board. The six, except the electricals, believed

that this was enough to guarantee progress toward a non-federal structure.

The mechanicals and civils see the agreement reached at the July meeting as a tactical victory on the road to the kind of CEI the three presidents argued for. They believe that the concession of individual membership means that, sooner or later, the CEI board will be elected by engineers regardless of their institutions. The electricals, however, point out that the board will still be dominated by representatives of individual institutions, even if elected, and that the July meeting made it clear that the nine will go no further.

Its decision to leave the CEI, accompanied, as it has been, by surprising frankness with the press, can be seen as a tactical manœuvre to apply pressure to the CEI board. But this would be a mistake. The electricals are convinced that the benefits of CEI membership are far outweighed by the financial and organisational constraints it imposes.

In fact, the CEI is not entirely its own master. Changes in its constitution have to be approved by the Privy Council, and much of the detail of the July compromise has to be hammered out. In particular, what the CEI euphemistically calls "personal services" has been referred to a "high-powered" working party for further discussion. If the new CEI is to have charitable status (a device for avoiding taxation), it cannot provide personal services—defending a member against victimisation, gleaning data on salaries, even supporting individual members in salary negotiations. Engineers, it seems, want these services so badly that it will probably be necessary for a new CEI *not* to be a charity.

Above all, there is the threat of a public inquiry into the organisation of engineers. There is little doubt that the Department of Industry is disenchanted with the CEI's cumbersome apparatus. Arthur Palmer MP, chairman of the Select Committee on Science and Technology, first floated the idea of a public inquiry. The more conservative members of the institutional world have already taken great exception to the way the electricals have brought the press into the debate on reorganisation by off-the-record briefings and effective public relations. They become almost apoplectic at the very suggestion of washing dirty linen in public. Squeezed by the twin threats of the electricals' resignation and a public inquiry, the nine may compromise further perhaps even to such an extent that the electricals could withdraw their resignation.

On the other hand, such patently public pressure might convince them that the electricals have gone too far. In traditional British manner ranks might then be closed to preserve a facade of unity. But when the outside world finally intrudes—perhaps when the EEC issue is forced—the facade will crumble and the CEI will have to agonise once more. As Professor G. H. Rawcliffe, a vice-president of the IEE and opponent of reorganisation, put it: "Laymen say that people who agonise about themselves so much cannot really be people of consequence."

FREE CATALOG
CHOOSE FROM OVER 4,500
UNUSUAL BARGAINS
OPTICS • SCIENCE • ELECTRONICS



1,000's OF HARD-TO-FIND BUYS FOR INDUSTRY

Brand new 180-page easy-to-read edition packed with new products, charts, diagrams, illustrations. On-the-job helps; quality control aids, unique, exclusive items to speed your work, improve quality, cut development and production costs! Loaded with optical, scientific and electronic equipment available from stock for industry, research labs, design engineers, experimenters, hobbyists.

ONE SOURCE FOR ALL YOUR NEEDS

Tremendous variety. Terrific savings. Countless hard-to-get surplus bargains. Many "one-of-a-kinds" nowhere else. Ingenious scientific tools. Thousands of components: lenses, prisms, wedges, mirrors, mounts, all types of accessories. Hundreds of instruments: pollution testing equipment, lasers, comparators, magnifiers, microscopes, projectors, telescopes, binoculars, photo attachments, ecological items, biofeedback equipment and America's largest collection of alternate energy sources: solar, wind, methane.

BUY DIRECT WITH MONEY-BACK GUARANTEE

Edmund ships over 5,000 orders monthly to world's largest industrials—every item guaranteed! Shop the catalog of America's largest Science-Optics-Electronics Mart with confidence! Get your FREE copy without obligation. Write now, in English for catalog "NS". To speed delivery, send $1.30 for airmail or 75¢ first class. U. S. currency only.

EDMUND SCIENTIFIC CO.
International Operations Dept.
382 EDSCORP BUILDING
BARRINGTON, N. J. 08007, U. S. A.
TELEPHONE: 609-547-3488, ext. 236
Cable EDSCORP

LOWEST RELIABLE AIRFARES
and the ABC FLIGHTS of the UK's LEADING AIR TRAVEL OPERATOR'S LICENSEES
(from London, Manchester, Glasgow)

are just some of the outstanding advantages of Europe's foremost travel & expedition club.

Return Fares to 115 Destinations including:

	from		from		from
NEW YORK	£99			NAIROBI	£140
TORONTO	£99			JO'BURG	£170
Accra	£125	Los Angeles	£149	Singapore	£230
Athens	£55	Lusaka	£230	Sydney	£355
Auckland	£405	Melbourne	£355	Tehran	£135
Bombay	£170	Rome	£45	Tokyo	£305
Delhi	£165	Salisbury	£195	Vancouver	£129
Lagos	£162	Seychelles	£175	West Indies	£129

WORLD EXPEDITIONARY ASSOCIATION
offers membership to everyone plus regular copies of *Expedition*, a unique 64-page colour magazine. For details, phone 01-584 9917 or 584 3433 (24 hrs—7 days) or fill in coupon below.

WEXAS, founded 6 years ago, now has over 17,000 individual and 1,200 Corporate Members.

Send to: WEXAS, 45 PALL MALL, MANCHESTER 1 or Department NS, WEXAS, US Headquarters Office, 45 Kingsley Rd, Englewood, London, SW19

Name
Address

Feedback

Scientists attack astrology

One hundred and sixty-eight scientists, including 18 Nobel prizewinners, last week launched an outspoken attack on astrology. Members of the American Astronomical Society or the US National Academy of Sciences, the scientists appended their signatures to a statement which appears in the September issue of *The Humanist*, a bimonthly magazine published jointly by the American Humanist Association and the American Ethical Union.

According to the statement, which has been sent to newspaper editors throughout the world, "Scientists in a variety of fields have become concerned about the increased acceptance of astrology in many parts of the world. We, the undersigned—astronomers, astrophysicists, and scientists in other fields—wish to caution the public against the unquestioning acceptance of the predictions and advice given privately and publicly by astrologers."

The statement goes on to say that it "is simply a mistake to imagine that the forces exerted by stars and planets at the moment of birth can in any way shape our futures. Neither is it true that the position of distant heavenly bodies makes certain days or periods more favourable to particular kinds of action, or that the sign under which one was born determines one's compatibility or incompatibility with other people."

Among the Nobel prizewinners supporting the statement are Hans Bethe, Francis Crick, Andre Lwoff, Sir Peter Medawar, Linus Pauling, Glenn Seaborg, Harold Urey and George Wald. Other internationally distinguished signatories include Harvey Brooks, Sir Alan Cottrell, Lee DuBridge, Thomas Gold, Philip Handler, Fred Hoyle, B. F. Skinner and Kip Thorne.

In a note which precedes the statement Paul Kurtz, editor of *The Humanist* says that "Both the American Ethical Union and the American Humanist Association have long been opposed to cults of unreason and irrationalism . . . We believe that astrology is being foisted on an unsuspecting public. The number of horoscopes, forecasts, articles and books published—even college courses offered—on astrology is disturbing, since there is no scientific foundation for its claims, and the public is rarely exposed to scientific criticisms of it."

The statement is accompanied by two full-length articles on astrology by Bart J. Bok and Lawrence E. Jerome. In "A critical look at astrology", Bok, emeritus professor of astronomy at the University of Arizona, claims that "During the past ten years we have witnessed an alarming increase in the spread of astrology. The pseudoscience seems to hold fascination especially for people of college age who are looking for firm guideposts in the confused world of the present . . . The public, young and old, has the right to expect from its scientists, especially from astronomers, clear and clarifying statements showing that astrology lacks a firm scientific foundation."

Twice Bok suggested to the council of the American Astronomical Society that it issue a statement pointing out the lack of scientific foundation for astrological beliefs but, on both occasions, his suggestion was rejected.

In his article, "Astrology: magic or science", Jerome argues that "astrology is false because it is a system of magic, based on magical 'principle of respondences'". This principle works on analogy; for example, Mars appears red; blood is red; therefore, Mars is associated with war. Jerome claims that the magical basis of astrology has been frequently overlooked, and that astrologers have tried to legitimise their subject by allying it with orthodox sciences—such as biological studies of body rhythms.



Jerome is particularly sceptical about the work of the French astrologer Michel Gauquelin, who has published correlations between month of birth and occupational choice. "Gauquelin's statistical studies," he writes, "present an interesting case wherein totally fallacious results appear to be scientifically valid". The fallacy is not in the statistical manipulations, which have been checked by other statisticians, "but rather in his basic statistical assumptions . . . Gauquelin has been improperly applying binomial probability statistics to the data, thus arriving at odds against chance on the order of one hundred thousand to one for statistical fluctuations that are actually well within chance level."

Jerome also attacks work done in Czechoslovakia on stellar-oriented contraception. "To sum up," he says, "legitimate statistical studies of astrology have found absolutely no correlations between the positions and motions of the celestial bodies and the lives of men. Those studies purporting to demonstrate 'planetary heredity' and astrological birth control are either based on fallacious assumptions or were improperly conducted or both. It is not too much to say that such studies are dangerously misleading, especially when the authors recommend that the magic of astrology can replace the knowledge and drugs of medical science."

Sir Alan Cottrell, former chief scientific adviser to the British government, and now Master of Jesus College, Cambridge said last week that he had signed the document because he thought there was a move in society towards irrationality—a trend that could be seen in a number of recently published books—and that this was worrying. He did not think, however, that the document was likely to have a large impact on the people most likely to believe in astrology.

Those with a professional interest in astrology immediately opposed the statement. In last Wednesday's *New York Times*, R. Donald Papon, described as director of the Academy of Mystic Arts in New York, dismissed the statement with the remark that "You can always get a number of scientists to sign a proclamation like this", while Diane Gusick of the Astrological Bureau in New York commented that "We have studied the subject and the scientists who made the statement have not".

Papon commented that there are "50 million Americans very much involved in astrology" and, in their statement, the scientists did refer briefly to the attractions of the field.

"Why people believe in astrology?" they asked. "In these uncertain times many long for the comfort of having guidance in making decisions. They would like to believe in a destiny predetermined by astral forces beyond their control. However, we must all face the world, and we must realise that our futures lie in ourselves, and not in the stars." *Martin Sherwood*

More resources for FOE

For the past two years, anyone reading the fine print on publications from Friends of the Earth will have noticed allusions to a mysterious entity called Earth Resources Research Ltd. Last week Earth Resources Research finally brought its light out from under a bushel of data and opened a new office at 40 James Street, off Wigmore Street—within a three-minute cycle-ride of FOE HQ at 9 Poland Street.

Under the direction of Graham Searle, founding father of FOE Ltd, ERR will have charitable status, and will concentrate on the research side of projects upon which FOE is campaigning, thus freeing FOE to cover more territory. Major research efforts are already underway in three areas—alternative energy sources for the UK, utilisation of wastes, and the relation between nutritional policy and agricultural policy in develped countries.

Several of FOE's experienced campaign staff have moved over to form the nucleus of ERR; Searle says he hopes the organisation will become a sort of environmental civil service, providing background materials for FOE's campaigning activities. FOE meanwhile, is luxuriating in the unaccustomed breathing space left by the move. Tom Burke, hitherto head-office coordinator of local groups—now 147 in number—has taken over the reins, and both Burke and Searle, mindful of the extra staff positions newly available, are looking hungrily for bodies to fill them.

Is there mushroom underground?

Have you ever wanted a spacious pied-a-terre 120 feet underground in the West country? Or a site for the first noise-free pop festival? Regrettably, then, you have just missed the chance to purchase two enormous underground military sites which have been declared surplus to requirements.

Sale is now "virtually settled" for the two former ammunition depots, at Monkton Farleigh near Bradford on Avon, and Eastlays near Corsham. The two depots, just west of Bath, provide almost two million square feeet of underground space. Seventy acres of surface land include entrance shafts and ventilation and cooling plants. Down below, the enormous complex has been divided up into "districts" interconnected by tunnels thousands of feet long. Each has its own underground power-house with diesel tanks and generators.

The depots have three miles of conveyor belts, forming a distribution network within the 25 districts. Each district comprises four to six acres of underground space.

The new owner of the site—Milton-Westcombe Farms Ltd of Shepton Mallet—refused to comment on possible future use. The company has probably paid in excess of £100 000—although the original MoD price tag was nearer £1 million.

The main difficulty will be getting planning permission for any work which would significantly affect the local environment—a problem which deterred two other prospective purchasers. One of these was a mushroom growing subsidiary of Heinz, who had bid for the 1·1 million square feet Monkton Farleigh site. According to a spokesman, the former dump could have produced 150 000 pounds of fresh mushrooms daily.

Both bases were built in the late 1930s in the old Bath limestone mines. The complex is still operational. During the war, the area produced aircraft and engines, which were shipped out from an underground railway station. The Monkton Farleigh depot also has its own branch station connected to the main London-Bristol line. Another of the old Bath limestone mines was used as a fighter group headquarters, and is still an important RAF early warning site.

Half a mile from Eastlays is another depot which was sold off in the 1950s to a Canadian with the idea of building an A-bomb proof vault. Wansdyke Security Ltd now run almost 100 000 square feet of security-guarded underground storage. The vault contains strongrooms, safes, and microfilm lockers, in which many large British and international companies store essential business records.

The vault is protected by an elaborate electronic security system, as well as being impenetrable to all but an oversize mole. Founder George Harris modelled the base on a similar one in the US at Iron Mountain. There is presently no other underground facility in Britain, although the British Museum still lease some tunnels at Bradford on Avon for the protection of valuable art treasures—they have had the lease since the last war. Certainly it is a safe place for anyone to be. "If things got hot", said one manager, "we could pull the lid over us."

Duncan Campbell



Part of Wansdyke Security's underground vaults

Going to meet Mendeleev

Meeting Edith Humphrey is something of an historical experience: for she was a student of Mendeleev, the proponent of the periodic table of the elements and one of the founding fathers of chemistry. Few of her contemporaries can still be around to compare notes with, for she celebrates her hundredth birthday today (11 September).

Miss Humphrey met Mendeleev in Zurich, where she went to study after first taking her degree in chemistry at Bedford College, London. "I did chemistry just because I liked it—that was where things were happening. At the North London [the North London Collegiate School, then under the headmistress-ship of Miss Buss] we did quite a bit of it. We had a teacher who had no degree but was very good."

Zurich, because of Mendeleev's presence, was the place where things were happening; but it was scarcely the accepted or the easy thing for an unaccompanied and hard-up English girl to get there. Her family, however, helped. "I think my father felt that the one thing you can do for your children is to educate them. I remember his saying, it's one of the few ways in which you can help your children to get something. Then my brother was mixed up with Brunner and Mond—he was an engineer, and he was with Mond, and I saw Mrs Mond before I went, and I think perhaps that, and the fact that I had a science degree before I asked for a place at the university helped."

There seems little doubt, however, that Miss Humphrey was actually abler than many of the other students—a fact which will surprise few women even today. "There were very few women students in Zurich," she says, "but fairly soon I was made assistant to the professor. I think being English helped—and also I knew more physical chemistry than most people there."

Life at the university was hard. "You were told what to do. You skipped a lot of lectures—you had lectures every day of the week. In chemistry, I think the lectures were from eight till nine, and botany from seven till eight in the morning. I never went to botany—having a job, I didn't take on many lectures."

Having a job, however, helped. Edith Humphrey had very little money, and Switzerland, even then, was not a country in which to be poor. "I was hard up, and I lived in a cooking school. Luckily I found some people who helped me—I had a scholarship but it was going to be very difficult to live on it. This lady, Frau Engelberger, she taught cooking in the mornings and we ate a very good lunch. We did badly at weekends; meals at weekends weren't anything like as good. I wasn't intimate with any Swiss people. It was partly the language, and partly because I just didn't get to know them. The people in the classes nearly all had considerably more money than I did. You could go and have a drink with them—but I didn't have any money for drinking. I got a salary, mind you, when I was assistant, and that eased things considerably for me. Whether my father would have helped me if I'd asked him I don't know, but he would very definitely have wanted to be asked."

Poor or not, Zurich where "so long as you worked and you paid your fees people didn't mind what you did," was a much better place for a girl to study than some other universities not too far away. When her time in Switzerland came to an end, Miss Humphrey was recommended to continue her studies under Professor Ostwald in Germany. "But they wouldn't have me in Germany. They said I could go to lectures but not practicals because the men wouldn't do any work!" Appalled by this teutonic stupidity, Edith Humphrey gave up and returned home.

Ruth Brandon

Hydrography needs new paymasters

Defence cuts make a reduction in the Royal Navy's hydrographic fleet inevitable unless alternative sources of funding are found. Can Britain afford to restrict a service the value of which extends far beyond immediate military needs to those of shipping and North Sea exploration?

Tony Loftas

On 17 July, 1974, Mr Frank Judd, the Parliamentary Under-Secretary of State for Defence (Royal Navy), announced to Parliament that a special Study Group had been set up to assess future civilian needs in hydrography. For over 150 years the Hydrographer of the Navy has been the national authority for hydrographic surveys and nautical charting. Founded in self-interest when losses to the Fleet from shipwrecks were greater than from enemy action, the Hydrographic Service soon expanded to serve not just the needs of the Royal Navy but the maritime community on which national wealth came more and more to depend. The Service is now threatened by a severe shortage of funds and manpower at a time when, with a burgeoning offshore industry, the country's need is as great as ever in the past.

The problems besetting the Hydrographic Service are symptomatic of a situation where new demands are being made at a time when funds as provided for in the Defence Review are diminishing. In his annual report for 1974 the Hydrographer of the Navy drew attention to the Service's growing involvement in the search for and exploitation of undersea energy resources. The exploratory and cartographic task posed by these needs is immense and, in the context of the energy crisis, resources had to be switched to this work, at the expense of other pressing tasks. In April 1974, the Admiralty Board gave permission for two ocean survey ships to be diverted to exploratory geophysical studies of the continental shelf. Even while this programme was in progress, further requirements emerged—notably the need to prove safe routes for concrete production platforms, which draw up to 80 metres, from deep-water construction sites on the west coast of Scotland to North Sea oilfields.

The dilemma of how to fund an expanding task in the context of a diminishing budget is not new to the Hydrographic Service. A crisis has arisen now because of the prospect of a reduction in surveying following the planned withdrawal of the Navy from areas east of Suez. Two of four ocean survey ships and one of four inshore craft are expected to be paid off in 1976. Concentrating defence effort on the Eastern Atlantic and Channel areas means that the needs of merchant shipping can no longer be subsumed within the military objective. At the same time, anticipated support of oil exploitation has little relevance either to defence or navigation. The question is not only whether the country can afford a strong Hydrographic Service, but how it should continue in the wider service of the country.

The Hydrographic Study Group has sought to define the national task, the resources needed to match it, and the priority which should be accorded to each requirement. Its report, presented in March this year, is still under review. A thorny problem seems to be the creation of alternative sources of funding to that previously allocated from Defence Votes. Replying to a question in the House of Commons on 22 July 1975, Mr Judd reiterated that only hydrographic work necessary for operations of the Royal Navy could be financed out of the defence budget. The issue of a separate Vote, he said, was under active consideration. Meanwhile the deployment of ships reflects the compromise between purely defence needs and those of the off-shore industry and world-wide shipping.

Hydrographic requirements

The needs of the Ministry of Defence for hydrography are increasingly at variance with civilian requirements. For example, the information required for the operation of submarines is ahead of that required by merchant shipping. On the other hand, an increasing number of merchant ships will, at their maximum, greatly exceed in size and draught any surface warships that exist or are likely to be built. Non-military demands fall into four broad categories: support of the offshore industry (bathymetric and geophysical surveys of the continental shelf, charting coastal shelters for mobile rigs, and identification of platform tow-out routes); provision of charts for shipping sufficiently accurate for modern deep draught vessels; surveys and charts of ports; and, finally, a mixed bag of services to other users including marine scientists, fishermen and leisure sailors.

The traditional requirements are, of course, those of shipping and related industries. The value of shipping to the economy of the United Kingdom is considerable. Few, if any, other industries in the country can still count themselves among the first three in the world league table. Its direct and indirect contribution to invisible exports has risen from a total of £392 million in 1966 to a total of £1028 million in 1973. The Admiralty Chart series, which comprises about 3300 charts, is widely used by both British and foreign shipping. The sale of charts in 1974 returned some £2·5 million to the Exchequer. This healthy demand for charts does not mean that nothing remains to be done. Even within the area of the UK continental shelf, 72 per cent or 134 450 square miles was either unsurveyed or surveyed only by lead line by July 1974.

The Hydrographer of the Navy's report for 1974 emphasised the continuing need for detailed hydrographic surveys in both home and overseas waters. Surveys off the Hebrides and East Anglia revealed dangerous shols "which could well have proved disastrous—the former to oil production platforms in apparently deep water, and the latter to


MOD

Figure 1 Inshore Survey Craft HMS Enterprise. *The Hydrographic Service has five of these craft which will soon need to be replaced*


MOD

Figure 2 Coastal Survey Vessel HMS Beagle. *The Hydrographic Service has four of these vessels which were commissioned in 1968*


MOD

Figure 3 Ocean Survey Ship HMS Herald. *Commissioned in 1974 this is the latest of four Hecla Class vessels operated by the Hydrographic Service*

shipping in a recommended seaway". Surveys in the English Channel revealed 95 uncharted wrecks, many of them dangerous to deep draught ships. And surveys off Belize revealed many coral heads, far nearer to the surface than expected, in the main shipping lane.

Major ports and some medium-sized ones—about 54 in all—have their own hydrographic surveying capability. In addition, a few ports have employed private or commercial survey firms. Surveying the remainder has, in the past, been undertaken by the Hydrographer in the course of coastal surveys. In many cases, surveys upon which Admiralty Charts are based are very old. An analysis, referred to by the Hydrographic Study Group, of 46 ports which have handled goods or passengers during the past 10 years showed that while nearly a third had been surveyed within the last 25 years, 11 of them had not been looked at for over 75 years. The UK has some 530 ports and shipping places.

Hydrographic surveys are only the start of the process: parallel charting effort must take place at the Hydrographic Department, Taunton. This cartographic work is not restricted to data from UK sources. The International Hydrographic Organisation's *Year Book 1974* lists 84 countries with national hydrographic offices, 46 of which produce charts. Information from these and other sources has to be assessed for inclusion in charts. In 1974, the original material received for processing by the Nautical Chart branches included 1737 survey documents and 1825 foreign new charts/new editions. The inflow of information is such that, with the present level of staffing, a backlog of chart revision has built up. Ideally, no more than 10 years should elapse between editions of a chart, but 42 per cent of the Admiralty charts have had no major revision in the past 15 years.

During the course of its investigations the Hydrographic Study Group identified a need for literally hundreds of ship-years of oceanic surveying throughout the world. In the case of shipping needs it reduced the figure to 36 ship-years in home waters and 34 ship-years overseas. Already these figures are exceeding what seems immediately possible within a decade using the existing hydrographic fleet. In fact, to meet all the requirements of both the defence and civil sectors identified by the group would involve a considerable increase in surveying effort. The priority tasks alone would require the addition of four coastal survey vessels and three inshore craft to the existing fleet. The hydrographer has estimated that an additional 155 staff would be needed at Taunton to handle the information coming from this fleet and other sources.

In an optimum programme envisaged by the Study Group, all the priority areas for defence and shipping, platform tow-out routes and energy source exploration would be completely surveyed by 1985 with the energy bathymetry continuing until 1988. At the same time all the most important unstable areas, such as the southern North Sea, would be continuously resurveyed. It would also be possible to maintain a programme of surveying in overseas areas, particularly the Persian

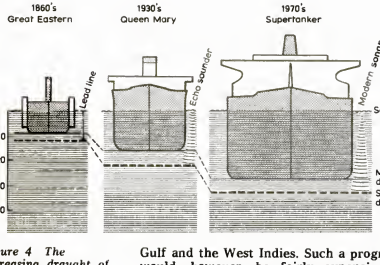


Figure 4 The increasing draught of ships imposes new technical standards on hydrographic surveying. Many charts used throughout the world are still based on lead line surveys and modern acoustic techniques continue to expose shoals in areas previously considered to provide safe passages for present-day deep draught vessels

Gulf and the West Indies. Such a programme would, however, be fairly expensive. The Group suggested a figure of some £88·5 million, of which just under half (£42·7 million) might be expected to come from the defence budget. The cost of the Hydrographic Office at Taunton might add another £2·705 million. Unfortunately, the Study Group was hard-pressed to suggest how the deficit of over £40 million might be made good.

One source of additional funds ought to be the Department of Energy. A major demand for surveying in home water comes from the energy programme. The work would need to be done whether or not the Navy was available. Of 22 British companies reported to have a surveying capability, probably no more than five can survey large off-shore areas to a standard required for charting purposes. The indications are that these companies are all fully occupied at present: recently a French company had to be contracted for a tow-route survey. In other words, this is not a case of private industry being thwarted by the Navy, but a legitimate use of its hydrographic capabilities on a contractor-customer basis—a basis very much favoured by the Select Committee on Science and Technology in its report on offshore engineering. The cost, therefore, should be a reasonable charge on the energy programme.

The Department of Energy is already a customer of the Ministry of Defence for one ocean survey ship. Its programme over the next three years will be directed primarily at petroleum exploration. Obviously, off-shore needs in this area are such that the ship could remain fully employed into the early 1980s. However, according to the Hydrographic Study Group, the Department of Energy's budget is fully committed for the next three years. Unless the offshore industry itself can be persuaded to make a contribution (an unlikely event) the cost of the ship can only be met at least until 1978-79 by increasing the Department's public expenditure allocation.

Other, less definable, sources of potential funds might lie outside the United Kingdom. The services of the Hydrographer might be contracted to other coastal states, either in a direct commercial deal or as a component of aid. This kind of arrangement could help to keep the present fleet operational and provide a possible source of data for the Admiralty Chart Series—always assuming, of course, that the coastal state would agree to release what might be considered confidential information. Such joint ventures might even have beneficial side-effects in the country's relationships with coastal states at a time when they are becoming increasingly sensitive about their offshore areas. A second ocean survey ship could be fully occupied in the foreseeable future in the Indian Ocean and Persian Gulf. This area is of considerable interest to merchant shipping, particularly operators of supertankers, and at least some local states are more than able to provide funds now that the Navy's military interest in the region has lapsed.

Allowing for the above and other funding possibilities, the future is still far from bright for the Hydrographic Service. In the Group's estimates, insufficient funds would be available to provide even for the continued operation of the existing hydrographic fleet, let alone an expanded one. At a time when total public expenditure has been fixed for three years (Cmnd 5879), a much reduced programme seems inevitable. Although urgent tasks such as charting platform tow-out routes or refuges could still be done, the energy bathymetry programme would probably have to be abandoned. If additional funds are not forthcoming from the Department of Energy, the energy source survey would have to be postponed for at least three years. But even a drastically reduced survey programme would still not remove the need for increased staff at Taunton: the backlog of data processing, charting and revision would still remain.

Contraction of the hydrographic fleet would have implications beyond delays in updating Admiralty charts. In the past, ships from the hydrographic fleet have joined in a variety of international scientific programmes. In 1974, for example, an ocean survey ship took part in the Atlantic Tropical Experiment—mounted as part of the World Meteorological Organisation's Global Atmospheric Research Project. Participation in such international programmes is part of a growing cooperation in intenational hydrographic and oceanic research that yields to individual participants far greater data than could ever be accumulated via its own limited resources.

The Royal Navy is not the only branch of the armed forces to feel the pinch of the Defence Review, nor has it shrunk from making its case. Of its many pleas, the case for an improved rather than impoverished hydrographic service seems the least chauvinistic. The effects of the proposed cut-backs in terms of lost commands are not spectacular. The work force at Taunton is already overloaded and unlikely to be pruned further. The defence requirement can be met. Thus the Royal Navy can fairly claim that the country's economy is primarily at risk. The pride and pockets of a few individuals may be affected by the reduction in hydrographic effort, but the real victims could be the merchant fleet, marine insurers and the offshore industry—and all for the want of a trifling sum of money in terms of current investments in these sectors.



1 Infra-red detector technology
2 High energy particle detectors
3 Supersonic aircraft materials testing
4 Computer programming for process control
5 Solar energy systems
6 Vacuum and cryogenic equipment
7 Bearing and lubrication research

Success in research, design and development comes to a company which can use its resources to solve a wide range of technological problems.

From finding a sharper edge for razor blades to developing an advanced technology for electric motors and generators. A diversity of needs met by a highly flexible approach.

One which belongs to IRD... **International Research & Development Co Ltd.**

At IRD, we've concerned ourselves with other people's problems for well over a decade ... by solving them.

Whether you're a small firm, or a very large company, whether you're involved in mechanical, electrical or electronic engineering ... instrumentation and control ... or engineering materials, we might be able to help you.

New materials and techniques...improving products and processes



1. Energy utilisation and conservation
2. Structural strain and vibration measurement
3. Flame-proof alignment lasers
4. Electrical power engineering
5. Swimming pool chlorinators
6. Underwater explosive welding techniques
7. Electric propulsion units
8. New cutting alloys
9. Paint adhesion studies
10. Biomedical equipment
11. Track rod fatigue tests
12. Heat transfer technology
13. Hydraulic systems
14. Environmental pollution monitoring

◀IRD's laboratories

Whatever your concern is, sooner or later you will come up against a technical project that's particularly difficult or requires a fresh approach. It may be happening to you now. It's also likely that it has happened in the past.

It may make excessive demands on budget, resources or expertise.

That's when you should call on IRD.

We provide a service with extensive facilities to tackle large or small projects and offer assistance to industry, government and local authorities.

We help our clients gain a technological and commercial advantage, and save them the costs of assembling their own staff and equipment for the job. In doing so, we provide a vital service — and have been responsible for many notable achievements — by working on the development of new materials and techniques, and by improving industry's products and manufacturing methods.

Backing our efforts is a wealth of experience. In mentioning a few examples of our significant achievements, we're also talking about the expertise behind them.

How can our knowledge help you?

Contact Marketing Manager J F Robinson (Tel. 0632-650451). He will arrange for the appropriate expert to discuss the problem with you. For all but the smallest job we will then produce a project proposal, which clearly states the terms and objectives. Naturally all work will be treated in the strictest confidence.

So it makes sense to talk to the right people.

IRD.

IRD... international research and development

Derek Brown, leader of IRD's explosive applications team, bringing us closer to Britain's oil . . .

"Some years ago, IRD developed methods for the explosive welding of steel pipes for domestic gas lines. Further research and development on these methods showed us that amongst the advantages of explosive welding was the ability to produce high quality welds underwater."

IRD is now working in co-operation with Vickers on a large



contract to develop techniques for the underwater explosive welding of 32 inch diameter pipe, a type being used in the North Sea oilfields

Tony Appleton, responsible for IRD's many electrical engineering activities . . .

Having explained how IRD built the world's first superconducting electric motor in 1966, he states "after completing a second motor, rated at 3250 hp, we are now testing a prototype marine propulsion system. In this we use superconductors in both the generator and the motor. The ratings of other marine systems we are designing are well beyond the practical limit for conventional machines."



At the other end of the scale, IRD has built 5 hp motors in which the armatures will run immersed in oil. Two motors of this type will be used to propel a small submarine. Each weighs 32 lbs and replaces a motor weighing 120 lbs. The result – an overall improvement in efficiency

A significant new IRD development — a portable laser microwelder designed for on-site uses . . .

"The ability to take it to a work-piece greatly extends its uses" states David Balfour, who heads the Applied Sciences Department.



". . . drawing on our considerable experience gained in developing a portable laser ophthalmoscope and bench-type microwelders, we have produced a hand-held welder for engineering applications.

"Aiming and focusing optics on the laser head enable the operator to direct the laser beam accurately onto the required location. A safety shutter and optical filters protect him from eye damage."

In effect, this new development is an answer to many previously unsolved welding problems such as the attachment of electrical contacts, thermocouples and strain gauges to research and production equipment – just one of a large number of significant achievements by Dr Balfour and his team.

IRD — working towards a better use of energy . . .



Backed by ten years work in solar cell technology, IRD is now designing low cost solar power supplies for special needs.

"As a result," says Roger Mytton, one of IRD's group leaders, "applications for these arrays are now feasible where low level power supplies are needed at sites remote from normal electricity supplies. A typical array provides 28 W at 28 V in bright sunlight. It charges a storage battery which then provides power day or night. Even with an overcast sky, the solar cells continue to give some charge to the battery."

These lower cost arrays can be used from polar to equatorial regions, in such equipment as navigation and warning lights, remote instrumentation and telecommunication links

Worn machine parts often cause expensive delays — and expensive replacements . . .

George Arthur's Materials Department has an answer, having shown that ceramic and metal coatings sprayed by the plasma



Peter Price, talking about impact testing . . .

"Thanks to IRD's exceptional facilities we are skilled not only in the conventional procedures of strain gauging but also in shock and impact testing.

"In a 125 feet high test tower we are able to drop large components down guides onto an arrester mechanism which brings them to rest with a predetermined deceleration.

"One of the largest items we have tested so far is a nuclear fuel container 13 feet long and weighing over 1500 pounds.

"The tower has also been used in the development of impact shock absorbers and can be used in the simulation of collisions at over 60 mph.

"Specially developed instrumentation is available to record travel, velocity and strain of the test piece."

Impact testing . . . just one of the industrial services provided by Peter Price's mechanical engineering department.

process can greatly improve the wear resistance and life of many components.

"We produce the coatings by feeding powder into a very high temperature plasma jet. The particles melt and are sprayed at high velocity onto the foundation surface . . . giving an adherent high density coating."

Pump shafts and seals, diesel engine components, shroud segments for gas turbines, and plant and production components in the food and textile industries are just some items that have benefited from these coatings.

...Providing industry with a confidential technological service



Dr. H. Rose, Managing Director of IRD, says:

"IRD is not concerned with research for its own sake. We are commercially minded and have one prime function — to provide industry with a confidential technological service aimed at advancing its commercial capabilities. We are always looking towards new ventures.

"Much of our present work stems from investments we originally made ourselves into new developments and techniques which, with subsequent support from government and industry, are now finding their way into new or improved products and processes at home and overseas.

"As one of the leading organisations in the international field of applied research and development, we have undertaken contracts throughout the world.
Many people are bringing their industrial problems to us. They have faith in IRD."



international research and development

To International Research & Development Co Ltd,
Fossway, Newcastle upon Tyne NE6 2YD

I would like to discuss.....

.....

.....

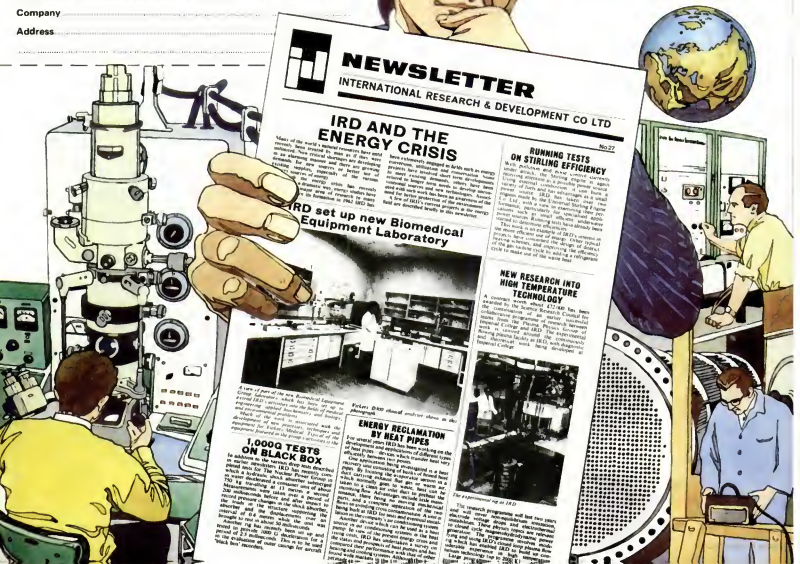
I would like to receive IRD NEWSLETTER ☐

Name.....**Position**.....

Company.....

Address.....

.....



Reprint requests abolished

A central clearing house for the circulation of reprints would have considerable advantages over the present wasteful system, for customers, authors and publishers

William Chan
is a biochemist at McMaster University Health Sciences Centre, Hamilton, Ontario, Canada

Many scientists are finding the traditional system of reprint requests an increasing nuisance. In some fields a single article may generate 500 or more requests and it becomes costly as well as time-consuming to meet these demands. Many requests come from persons totally unknown to the author, and one suspects that some have only a marginal interest in the article.

It is, therefore, not surprising that many authors have given up sending out reprints. As a result, genuinely interested inquirers cannot rely on obtaining a reprint through the request system. Many research workers have consequently switched over to photocopying, in spite of the greater bulk and poorer quality of photocopies. Furthermore, the labour and material costs in photocopying are substantial and the legal question is uncertain.

The situation could be greatly improved if we could establish a Central Reprint Clearing House (CRCH). All that is needed is one such agency in North America and another in Western Europe. Then for the more widely-read journals, a relatively large number of reprints could be produced at the time of publication. The author would receive 50 free of charge, the rest being distributed between the two CRCHs. The reprints would then be obtainable by any person through the use of standard cards with self-addressed labels. Pre-paid coupons would be attached for payment of the number of reprints desired.

Thus a person who wished to secure at any one time 10 different articles would not need to write to 10 different authors but instead could send the information and payment in one envelope. He would be practically certain not only that he would receive the reprints but also that they would arrive by return of mail with all 10 articles in one envelope. The greatest benefit should be to the large institutions which already have telex. The information could be collected centrally in such an institution and transmitted daily via telex to the CRCH. Within the institute, distribution of the received articles as well as accounting could be handled centrally.

At the CRCH, tremendous possibilities would exist for automation. Even single article orders could be handled cheaply if the order were in the form of a standard punched card that was machine read, with the article automatically placed in an envelope showing the return-address provided by the purchaser. The savings in automation and in the mailing of a number of articles together would be considerable. The costs of reprints should also be lower if a fixed and relatively large number of reprints were produced with each issue of a journal.

If such a CRCH were established and run by the government as a non-profit agency, I feel that the price might be brought to as low as 50 cents per copy (about 20p in British currency). This would be competitive with



photocopying and if authors would stop sending out free reprints, I believe most people should find it better to pay for reprints than to photocopy. The proposed system should not represent an additional cost to scientists because on the average what they save in reprints of their own articles should pay for what they wish to read. If the cost were borne by the reader rather than by the author, it should prevent abuse such as requests from persons with only marginal interest.

Another advantage of the system would be that authors could obtain more copies of their own reprints at any time. Also, it would be possible to obtain large numbers of copies of a particular article for use in classes where the original literature is discussed.

Financial savings

From the point of view of agencies funding research, such a system should eventually provide savings because of its greater efficiency. As so much scientific work is publicly financed, and various agencies already exist to promote international cooperation, there seems little reason why the CRCH could not be run on a non-profit basis by governments. The system would also benefit the publishers if the fees they received from the CRCH exceeded the cost of producing reprints. In effect, publishers would recapture part of the printing business now lost to photocopying.

Under the proposed system, some authors might wish to send free reprints to countries where their colleagues cannot pay for them (at least not in convertible currency). Also, arrangements could be made (eg with countries in Eastern Europe) for the CRCH to exchange reprints with equivalent organisations in other countries, thus overcoming currency restriction problems.

It is also possible to compensate for the loss of any psychological benefits in reprint requests if scientists would write cards to one another to say "Dear colleague, I have *read* your article . . ." (perhaps adding comments such as: with great interest). Moreover, authors might be allowed to find out at intervals how many reprints have been sold by the CRCH. It would surely be gratifying for some to know that so many people would actually pay to read their articles.

Review

A matter of breeding

by Madeleine Simms

The human pedigree
by Anthony Smith
George Allen & Unwin, pp 328, £5·95

This is a racy and compulsively readable book about the social aspects of genetics. Anthony Smith is an old hand at scientific popularisation and has a splendid gift of narrative. He explains the basic biology and statistics of the subject in terms that convey meaning even to the non-scientific and innumerate. He illuminates points with fascinating examples, such as the careful breeding of Leonardo da Vinci's nephew, who was designed to recreate his uncle's genius and nearly did; and the progress of the "Hapsburg jaw" and the "Burgundian lip" among historical curiosities.

One chapter gives a detailed account of how the Nazis managed their pronatalist and Master Race policies. The king-pin of this particular department was Himmler, who looked less like the blond beast to which this policy was dedicated, than any German with the possible exception of Goebbels and Hitler himself. One wonders whether such perverse observations ever flitted across the consciousness of the goose-stepping Herrenvolk. Probably not.

In 1935, Himmler established an organisation called Lebensborn ("Spring of Life"). This had two main functions: to stamp out abortion, and to breed the Master Race by means of positive eugenics. A chain of state brothels was instituted, at which racially pure members of the SS were mated with medically approved blue eyed blond Nazis who were over 5 ft high. They did not know each other's names, and their children became the property of the state. If the Frauleins proved obedient and fertile they were invited back again next year.

By the end of the war there were thought to be some 11 000 Master Race infants in state institutions. "As a genetic experiment", concludes Anthony Smith, "it has nothing or little to teach us... The attempt to breed from the chosen few was without consequence and the few products have now gone back into the melting pot—along with the rest of us." Which is something to be grateful for.

Passing from positive to negative eugenics, Anthony Smith points out that one-third of the permanent inmates of British mental institutions are there due to mongolism. Many of them have long since outlived their parents and become totally dependent on the state. How does this fact square with the now popular slogan "A Woman's Right to Choose"? Ought not every high risk older woman who becomes pregnant feel duty bound to have the test by amniocentesis that can forecast this condition, and to opt for abortion if the prognosis is unfavourable? Or has she the "right" to choose to inflict this burden on the state? Has any high risk couple the "right" to refuse genetic counselling and to ignore the likely burden it is thus placing on the community?

Surveys have in fact shown that most parents who are sufficiently well-informed, act responsibly in this situation and do not take absurd genetic risks. But what about the social as opposed to the genetic risks? Genetic responsibility now commands almost universal assent. Social responsibility of the same order is still fraught with all kinds of trauma and inhibition. If the only reason for this were the argument that we do not yet know enough to make sensible predictions, this would be understandable. But the objection is on principle. The right to breed, whatever the circumstances, is considered inalienable. Any politician will be vindictively assailed (and has been in recent memory) who dares suggest that there are social high risk categories where further reproduction will almost certainly end in the state being handed a heavy burden for a lifespan, at the expense of other socially desirable objectives.

It is not least of the virtues of Anthony Smith's book that he provokes thought about unmentionable issues which 20 years from now will be the subject of open and vigorous discussion

Madeleine Simms is a research fellow at the Eugenics Society

Language, truth and poetry
by G. D. Martin
Edinburgh University Press, pp 354, £6·00

Voltaire was mistaken. Language, not chastity, is man's greatest invention. But it is an invention encased in a chastity belt fitted by monkish logicians and linguists. So that words are denied the frolicsome and fertile promiscuity they deserve to enjoy in their natural habitat, everyday speech, and even more, in the domain of poetry. This, in a nutshell, is Dr Martin's plaint.

His launching-pad is the "semiotic triangle", that is, the set of relations between (i) a word; (ii) the idea(s) it represents in the mind; and (iii) the object it refers to (the "referent") in the outer or inner world. Every conceivable aspect of this theme is played with verve and gusto, including abstract referents, fictitious referents, non-existent referents, concepts ripped from their referents and, finally, concept and referents made one in the flesh or spirit. This last identification is made manifest in the surrealist art of Marcel Duchamp and in the poems of that Master of Words, Mallarmé.

One thing must be said in praise of the learned author of *Language, Truth and Poetry*. He doesn't beat about the bush. Although occasionally tempted to "toil portentously", he makes his position crystal clear. He is Enemy Number One of all those who claim that formalisation, logical or structural, can be imposed on language or meaning in literature. For the poet's mind has infinite potential for generating novel meanings.

Language, it seems, is a three-fold cord. One strand is everyday speech, which proceeds by rough and ready "pigeonholing" of the things it refers to. A second strand is the language of science, which explores "reality" by striving for total precision and freedom from ambiguity. The third strand is the language of poetry, *par excellence*, the metaphor, which penetrates a different "reality" by exploiting nuances numberless and the boundless range of meanings that can be assigned to them.

Beyond this triptich, Dr Martin essays to resolve an enormous clutch of problems in the philosophy of science and literary criticism, problems prompted by the infuriating question of the nature of meaning. The ramifications for science, as for poetry, are far-reaching.

The heart of the book lies in Dr Martin's theory of "apparency", which is the poet's target. It is not for him to use words as algebraic counters merely for classification. He must squeeze out their innermost juice, their connotations, and content. He must make them echo and reverberate. If language may be thought of as a vast filing-cabinet with a single word on the front of each drawer, the poet insists that we open the drawer and rummage freely inside. Nor is the poet restricted to the evocation of particular images or specific events. Abstraction and generalisation are his *metier* too, but in figurative guise.

Like a knight in bright and shining armour riding a white palfrey, Dr Martin issues forth to rescue the damsel "Language" from the clutches of the dragon "Linguistic Logic". His zeal nearly costs him his life, for he imagines he is at perfect liberty "to define 'possibility' as entailing a continuous number of degrees (exactly like 'likelihood')", in reckless disregard of the need for a measure or scale of "possibility". But in the end, armed to the teeth, as he is, with innumerable apt citations from a myriad sources, his perilous quest is crowned with triumphant success, and he and the maiden live happily ever after.

When Dr Martin insists that the scope and singularity of a word's connotation are peculiar to the speaker or listener, he hits the nail right on the head. If the connotation is not fixed and immutable, language becomes intelligible only on the basis of "a vast range of experience of the real world". A human mastery of language, consequently, is forever beyond the reach of a machine or computer.

Language, Truth and Poetry can be warmly commended to students of science and literature alike. Deeply impressed by the author's evangelical fer-

vour, they will learn to distinguish the differing functions and limitations of language in its widely scattered empire of logic and poetry, and they will be vouchsafed a beatific vision of the Two Cultures, not as irreconcilable foes, but as fraternal twins.

John Cohen

Breeding endangered species in captivity

by R. D. Martin
Academic Press, pp 420, £12·80

In May 1972 the Jersey Wildlife Preservation Trust and the Fauna Preservation Society jointly held a small conference in Jersey, and three years later its proceedings are published. The delays of publication have in this case had a useful result: we can measure the good intentions of the meeting against a reasonable period in which to carry them out. And by any reckoning, zoos can claim little credit for reform in the past three years.

In his summing up of the meeting, Sir Peter Scott said that the main problems of breeding animals in captivity were political; he might more honestly have phrased it as bloody-mindedness. There are far too many zoos—including some which have a high public reputation as conservationists—which will keep a single animal of breeding age in complete isolation for years rather than allow a competitor to borrow it briefly for pairing. Indeed, the few honourable exceptions seem to be cynically used by the majority of zoos as a public relations smokescreen.

There are even ugly rumours of so-called respectable zoos destroying rare animals at birth rather than rearing anything which is surplus to their display requirements.

At the Jersey conference, the participants spoke enthusiastically of the zoo liaison group which the International Union for Conservation of Nature (IUCN) was about to set up; three years later, the group is still not functioning. The fault lies less with IUCN than with the zoos, which have shown an almost total lack of interest in the subject.

This volume is a useful compendium of all the well-rehearsed stories about breeding endangered species in captivity: Peter Scott's flamingoes and Hawaiian geese, Whipsnade's cheetahs', Philip Wayre's eagle owls, whooping cranes at Patuxent in Maryland, Arabian oryx at Phoenix, Arizonia. But it is surely high time that the few dedicated zookeepers who undertake such projects ceased to allow the selfish menagerie-managers to hide behind other people's successes.

Jon Tinker

Scotland

An archaeological guide from earliest times to the 12th century AD
by Euan W. MacKie
Faber and Faber, pp 310, £5·50 cloth, £2·95 paperback

Following hard on C. Houlder's companion volume on Wales, Euan MacKie presents the ancient monuments beyond England's northern border in time for the holiday season. *Scotland: An Archaeological Guide* is perhaps rather tough meat for the ordinary tourist with too little general background information, but it is otherwise nicely written and well illustrated and provides the kind of information needed by the inquiring visitor to a selection of the most important and best preserved structures from the Stone Age down (in this case) to the castles, monasteries and great churches of the 13th century AD. The to the castles, monasteries and great and 26 smaller regions and, although actual tour itineraries are not suggested, these can be worked out easily. Full details are given about how to get to the sites, many of which are remote, poorly signposted or difficult of access.

It soon becomes obvious how recent much of our knowledge is about the archaeology of Scotland, and this up-to-date guide contains a great deal of new information and new theories, including ideas about astronomical observatories in about 2000 BC which are Dr MacKie's special interest. It is also fascinating to see how the early buildings, monuments and art reflect the interaction and distinctive character of the various elements that went into the melting pot that was early Scotland—Scots from Ireland, Picts, Norwegian Vikings, Northumbrian Angles and others. But perhaps the most lasting impression left by the book and strongly reinforced by visits to the sites is of the remarkable individualism and often uniqueness of the ancient monuments of Scotland.

More than anywhere else in the British Isles we find exotic—indeed eccentric—architectural forms and art styles, due in many cases doubtless to a local development in isolation from the main stream of imported traditions and leading to sometimes highly spectacular variations and in other instances representing quite independent imaginative invention. Ingenuity, skill, adaptation to local conditions and resources, and sturdy self-reliance are Scottish characteristics with a very long ancestry, and this guide will introduce a great many people to the outstanding examples of the fine archaeological heritage built on these qualities.

Stanley Thomas

Technology around us series*

series editor G. Terry Page
Hart-Davis Educational, £1·35 each

Little thought seems to have been given as to how these awkwardly shaped booklets will be stored on library shelves or as to how many terms these soft covered, staple bound, brochure-like booklets will last in the demanding hands of children. The small print will do nothing to encourage the below average reader into the books.

The World of Detergents uses difficult and sometimes tedious language seemingly aimed at the upper end of the secondary school, yet the content and project work could be easily handled by much younger children. It is a pity that colour has not been more extensively used to clarify some of the more complicated diagrams.

Language more attractive to children is utilised in the book on *Aircraft Flight*. The diagrams and photographs are well chosen to complement the text, making the book more attractive to slow readers. The theory of flight is dealt with clearly and there is ample provision of well thought out project material.

The most originally presented of the current three books is *Traffic and Roads*. Little space has been devoted to such themes as "the history of the motor car" or "the history of roads" for which an abundance of material already exists. Instead the emphasis has been given to modern traffic and road technology. The chapter on "making a traffic survey" provides teachers and children with clear and precise instructions on how to achieve some useful end results. As with all the books the effect of technology on the environment has not been overlooked.

Publishers seem to believe that any booklet on a popular school theme can be sold solely on the merit of an attractive cover and fail to appreciate that particularly in these times of educational cuts the need is for value for money. I do not believe that at £1·35 for 60 pages this need has been met.

David Boas

**The world of detergents*, by Mary Lucia, pp 62; *Aircraft flight*, by G. Terry Page, pp 64; *Traffic and roads*, by G. Terry Page, pp 62.*

ATLA ABSTRACTS

is published twice yearly and contains current information on "Alternatives To Laboratory Animals". Coverage includes a variety of disciplines in a wide selection of world scientific literature.

Have you a copy in your Library? If not, a free specimen will be sent on request.

FRAME,
312a Worple Road,
London SW20 8QU

(Fund for the Replacement of Animals in Medical Experiments)
(Registered Charity No. 259464 England)

Tel: 01-946 1450



Phacops rana crassituberculata from the Devonian (Cazenovian), Sylvania, Ohio. Trilobites are so named from their apparent longitudinal separation into three "lobes"



Cross-section of Triarthrus showing walking and swimming legs



Mirraspis mira from the Silurian (Wenlock). The lateral lobes carry both long and slender spines



Cornuproetus sculptus from the Devonian in Czechoslovakia. As the trilobites increased in size so they periodically shed their outer hard case



Most trilobites could roll up to expose only their carapace—probably as a defence mechanism

Trilobites
A photographic atlas
by Riccardo Levi-Setti
University of Chicago Press, pp 214, £13·75

Just published is a pictorial record of some of the most remarkable animals ever to inhabit our planet—the trilobites. These woodlouse-like arthropods first appeared in the early Cambrian seas, about 600 million years ago. How these segmented creatures evolved has long puzzled palaeontologists for it seems they just suddenly arrived here and spread themselves wide. Did they evolve from the lowly segmented worms in some enclosed area only to become dispersed when the walls of the confine were shattered by some cataclysmic happening? For sure they were equipped to travel. Not only did they have walking legs but also special oar-like swimming legs. I'm surprised that more attention hasn't been paid to the possibility that they arrived on Earth from elsewhere in the universe... Wouldn't their hard critinous outer skeleton have protected them in space flight?

However it was that trilobites got here, there can be little doubt but that they settled down to a "successful" existence for some 350 million years. But come the end of the Carboniferous period (beginning of the Permian?), the trilobites disappeared just as suddenly as they had arrived in the Cambrian. Agreed, in some instances, morphologically, they seemed to go berserk, but was this the prelude to a terrestrial evacuation or just the sort of bizarre development that has heralded the imminent extinction of other lifeforms (prior to man providing a helping hand, that is)?

While we know much about the distribution of the trilobites, its general anatomy growth and development, only recently have we begun to learn something of the creature's soft parts. The importance of Levi-Setti's atlas is that it makes accessible a wide range of superbly preserved specimens for systematic examination. The major part of the work is a 132 page portrait gallery of the nine main orders of the Trilobites.

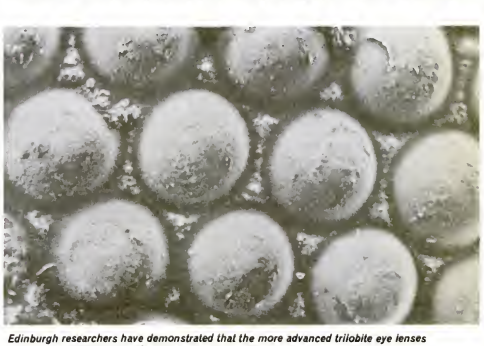
In all Levi-Setti has taken or borrowed 200 magnificent pictures of these small animals (usually a few centimeters long, but ranging from 3 mm to 70 cm). Of special interest are the details that he offers of the compound eyes set each side of the central lobe of the trilobite's head or "cheeks" (not always, though, for some species it seems were blind).

Although our knowledge of the stratigraphy of Earth has advanced in leaps and bounds, thanks to advances in geophysics, fossils still remain the means most accessible to the field geologist for putting an age to a sedimentary rock. The diversity of the trilobite form has long provided stratigraphers with valuable markers for the Palaeozoic rocks. They and their acolytes will find Levi-Setti's book an inspiration. But it's a picture book and was never intended to be a reference work to the whole and diverse range of the order.

Richard Fifield



That the trilobite's eyes had an extraordinary depth of field even in the low intensity illumination of the deep ocean can be shown with a microscope by "viewing" through them



Edinburgh researchers have demonstrated that the more advanced trilobite eye lenses produced a sharp focus and an image free of aberration

Introduction to marine geology and geomorphology
Introduction to physical and biological oceanography
by Cuchlaine A. M. King
Edward Arnold, 2 volumes, £9·90 and £11·00 respectively in hardback, £4·90 and £5·50 in paperback

Professor King has expanded her successful *Oceanography for Geographers* into two fact-packed volumes to accommodate some of the explosion in oceanographic research during the past decade. Although presumably intended for undergraduate teaching, they will also be useful as readable reference works for the non-specialist. Probably the only unfortunate aspect of the two volumes is the perpetuation of the myth that oceanography is in some way a small part of the domain of the physical geographer. This is apparent in the labelling of the *Geology and Geomorphology* book as volume 1 and the *Physical and Biological* book as volume 2. It is the substantial developments in the measuring sciences, mainly in physical oceanography, which have recently accelerated the understanding of all aspects of oceanography including marine geology and geomorphology.

Introduction to Physical and Biological Oceanography starts with a description of the water itself, followed by an explanation of its principal modes of circulation. Tidal theory is complex but the chapter on tides is probably acceptable to the non-specialist. The chapter on waves, one of the faster-changing topics, has been brought up-to-date and covers tsunamis and surges as well as storm waves. The biological half of this volume is a readable account of the fertility of the sea, a description of the immensely varied life it contains, and the resultant productivity, leading to extensive exploitation and over-exploitation. The various uses to which the sea has been put, such as dumping of refuse, including radioactive refuse, and consequently the urgent need for control and conservation, are discussed. This leads naturally to an appendix by Edgar Gold on the present situation of the Law of the Sea and Ocean Resources.

The other volume, *Introduction to Marine Geology and Geomorphology*, explains the processes which have contributed to the development of the oceans as we know them today. Many seemingly unrelated facts fall into place as the theory of plate tectonics unfolds like a detective story. The origins of the continental margins are described and their importance to weather and biological productivity are mentioned. Deep-ocean morphology is shown as a fascinating study, and ocean sediments from fine clays to manganese nodules are described in a wealth of factual detail. The final chapter deals with the origin of ocean water, and with changes in sea level.

Diverse sources have been systematically combed for material for these two reference and textbook volumes. Although packed with facts they are attractively written and rewarding to study; the books are well produced and the number of typographical errors is commendably small. A valuable innovation is the "further reading" list at the end of each chapter. It will be a dull reader who fails to find in these books an exciting story.

Laurence Draper

Principles of microbe and cell cultivation
by S. John Pirt
Blackwell Scientific, pp 274, £10·50

Growth of cells, whether they are bacteria, fungi or plant and animal tissue cultures, can be treated in a generalised way. In this book Professor Pirt develops clearly and logically the mathematical equations which can be applied to growth rates and growth yields and to the factors which influence them. He discusses temperature, pH and various nutritional requirements, and has most to say about oxygen and methods available for controlling aeration and measuring oxygen tension. Most attention is paid to growth in chemostat culture and the advantages to be gained by working under steady state conditions. There are good descriptions of the principles of chemostat design, including the elaborations which may be introduced to give better utilisation of growth substrates, such as linking chemostats in series and introducing systems of feedback of biomass.

The possible industrial applications of the principles described are discussed rather sketchily. A brief section on growth of mixed cultures is of interest but is almost entirely confined to the growth of a pair of well-defined laboratory strains under a limited range of growth conditions in continuous culture. The author points out that mixed cultures are much more usual than pure cultures in the natural environment but does not develop this interesting theme or mention that "feast and famine" may be more usual than a constant supply of potential growth substrates. Batch culture is not omitted completely but a description of the advantages of continuous culture is not matched by an appreciation of the many purposes for which growth in batch culture is much more suitable than continuous culture.

Little attention is paid to the ways in which the regulatory mechanisms of enzyme synthesis affect growth rates or, on the other hand, the ways in which growth studies have been used to elucidate regulatory mechanisms. This is not surprising as the author believes that "Since growth of living cells is a process of auto-synthesis, growth must conform to the principles of chemical autosynthesis" and elaborates this by discussing the models of autosynthesis developed by Hinshelwood. This may explain why, in a book extolling the virtues of the chemostat, some very interesting chemostat studies on regulation are omitted. For example, the selection pressures resulting from growth with low concentrations of poor substrates leading to the selec-

Advertisement

TREASURE HUNT

PLANETS
Distance from Sun (km) = . . . Equatorial Radius (km) = . . .
Orbital Eccentricity = . . . Polar Flattening = . . .
Sidereal Period (years) = . . . Rotation Period (hours) = . . .

GREAT PYRAMID
Baselength = 230.364m (Cole)
King's Chamber = 20 x 10 cubits.
Sir Flinder's Petrie's "King's Chamber" cubit = 0.52405 m.
Long Axis of King's Chamber = 11.02 m S. from Pyramid centre.
The Entrance Corridor runs from the N. face of the pyramid to the E.side of the King's Chamber.
Axis of Entrance Corridor = 122.42 m from W. side of pyramid.
A "seked of 5 palms" defines a slope which, for a horizontal distance of 5 palms, would rise by 1 cubit.
Site: 29°58¾'N 31°08'E 0.05km
Pyramid (slope): Semibase/Height = π/4 = 0.78539816
Corridor (slope): Horizontal/Vertical = 2
Perimeter/Height = 2π = 6.2831853
Height = ... Baselength + Height = ...

SATELLITES
Deimos revolves round Mars (. . .) times for 1 Earth rotation.
Phobos " " " (. . .) " " " " "
Deimos is (π x . . . . .) km above the Martian equator.
Phobos is (. . . . .) km " " " " "
–Deimos would orbit Earth (. . .) times for 1 Earth rotation.
–Phobos " " " (. . .) " " " " "
Jupiter V orbits Jupiter (. . .) " " " " "
Height above Jovian equator at which Jupiter V orbits = ...
Revolutions, and Heights, of other satellites: . . . .

VOLCANOES
Latitude of Earth's largest volcano (Hawaii) = . . appx.
Latitude of largest Martian volcano (Nix Olympica) = . . appx.
Latitudes of largest volcanoes on other planets: . . .
Longitude of Earth's largest volcano = ...

Height above Earth's equator to which north slope of Great Pyramid points = 2π x . . . . . km

Proceed only if the main aspects of the Great Pyramid, etc seem adequately to suggest the main aspects of only one planet.

This "Height" when aligned through the Earth to the Great Pyramid, defines with accuracy, a latitude intermediate between that of Hawaii and that of Nix Olympica.

If the same kind of alignment is made through Mars, using the height of Deimos and the "accurately defined latitude", what latitude is indicated on the opposite surface of Mars?

If a Great Pyramid Shape were positioned on Mars so that its north slope pointed to the orbit height of Phobos, what would be its latitude on Mars?

What latitude would this alignment indicate on Phobos?
Phobos always presents the same face to Mars, so the longitude on Phobos for this alignment would be 0°.

At what latitude would a Great Pyramid Shape need to be positioned on Jupiter for its north slope to point to the orbit height of Jupiter V? (Polar flattening more significant here.)
What latitude and longitude would be indicated on Jupiter V?

Much of the material here was assembled from "Destiny Mars" (published in July by Downs Books at £1).

tion of constitutive or multiple gene mutants and the advantages of such mutants for industrial processes is not discussed. Again, nitrogen is treated as merely another growth requirement and yet carefully controlled chemostat studies comparing nitrogen-limited and carbon-limited growth led to the discovery of the alternative systems for ammonia assimilation at high or low ammonium ion concentrations. *Patricia Clarke*

Man and wildlife
by L. Harrison Matthews
Croom Helm, pp 130, £4·95

"It is entirely right that man should harvest marine mammals, for their oil, skins, meat and other useful products, but obviously foolish for him to expend the capital as well as taking the yield." In fact whether it is marine mammals, land mammals, birds, fish, insects or plants man has a right to exploit them whether for food, clothing or shelter. He is himself a part of wildlife and as such part of a complex network of natural cycles. Change one part of a cycle and inevitably there will be repercussions in other parts.

Who would have thought that the building of the Aswan High Dam in Egypt would bring such widespread ecological change, not only to the land, but also to the Mediterranean Sea? Here the sardine fishery of 18 000 tons annually has come to an end because the yearly flood of nutrients brought down from Nubia has stopped. Man is adaptable. I've no doubt the sardine fishers have found other occupations; but what of the sardines. There are millions of them teeming in the sea yet a few more Aswan dams and there might not be. Once there were thousands of great auks who nested on islands in the Atlantic. Unable to fly, they were an easy source of food and bait for fishermen. Then suddenly there was none. It is chastening to realise that the last was killed in 1840 to be stuffed for a naturalist. Do we, would we, know better in 1975?

Man and Wildlife is a readable attempt by Harrison Matthews to draw our attention to the ways in which man interacts with wildlife. Taking first plants, then the animal kingdom group by group he shows how man interacted with them in the past, often culling for food in a subsistence economy. It is not until the commercial exploitation begins—harvesting as cash crops rather than subsistence crops—that man's activities become seriously destructive to many species. History shows us the consequences of our greed and thoughtlessness, whether it be the near extinction of the great whales or the repercussions of building the Aswan dam.

This is an unusually positive book. There are no histrionics, no holier-than-thou judgements. It is entirely right that man should exploit his environment but if he wants to continue to do so he would be a wise Homo sapiens to calculate the consequences of his continued exploitation.

Success in keeping the world a pleasant place to live in depends primarily upon educating the population to limit its numbers, and secondarily on teaching it to understand and respect the fragility of the environment so as to avoid destroying it. It is towards this end that Harrison Matthews has written a simple, direct book for the people.
Theya Molleson

Art

A trick of light
Artificial lighting effects in painting, before and after Edison
Science Museum London until 23 September

This exhibition has been seen already in Eindhoven and Amsterdam and is shortly moving to Munich. Its showing in London coincides with the meeting of the International Commission for Illumination, the delegates to which are being received in the exhibition hall this week. Organised together with the *International Lighting Review* and sponsored by Philips, it is, as Dr W. Weston, the director of the Science Museum, said in her opening remarks, an unusual exhibition to have at the museum.

The tacit reason for this is, I think, that it is descriptive to the exclusion of all experiment. It represents a history of paintings containing artificial light, largely in colour, a fact which only helps to stress the poignancy of Picasso's ever heart-rending black and grey Guernica. The majority of the exhibits are reproductions, although some of the non-London collections, such as those of Derby and Manchester, have lent originals by Joseph Wright and Henry Moore.

The reproductions of some of the paintings which I know really well are disappointing. For example the monument to the candles—Honthorst's Christ Before the High Priest—is very much pinker because it was painted by candle or torchlight; the reproduction fails to give any inkling of this. Rather oddly, this failure to reproduce warm tones correctly seems more widespread than is true of the cooler ones: but if we have savoured Paul Delvaux's unsettling lunar lighting, then the yearning he kindles appears somewhat stunted in reproduction.

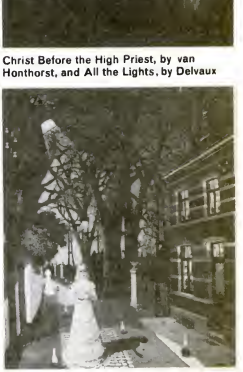
The motif is light and the sequence of the exhibits is chronological in style if not in date. The exhibition is entirely free from comment, because the material has been assembled by Jon Jansem, a dedicated lighting expert, from "a six-month search through photo-archives . . . in which some 4000 slides were examined". I imagine that an art historian would not have been satisfied with inserting adverts for electric lighting at the appropriate point in time, ie shortly after Van Gogh. He might have considered juxtaposing the artist's Potato-Eaters, lit by an oil lamp, and dank and yellow in their abject poverty, to, say, Falon's water-colour of the spectral shimmer seen round an electric lamp when there is a slight mist or our glasses are huffed. He would certainly have drawn the visitor's attention to the extraordinary lighting in Rembrandt's Feast of Belschazzer, the phosphorescent tones of which can be a puzzle only to those who forget that the artist's countrymen were a nation eating fish, and therefore acquainted with the nocturnal eeriness of fishbones.

The greatest problem of artist trying to render the effects of sources of different colour temperatures in a single picture is presented by the peculiar colour adapting mechanisms of the human eye. As Delvaux's All the Lights demonstrates, the problem is insoluble. However, had the exhibits been selected in consultation with an art historian, we would have been allowed a potentially most enlightening comparison with earlier and greater failures, such as those due to Raphael and to Altdorfer.

If the Science Museum were to organise such an exhibition, rather than act as host, it would, I hope, be able to secure the loan of more originals. The idea that the impression of luminosity we obtain is unaffected by the nature of the surface does not bear a moment's examination. The notion that torch, moon, and bulb-lit scenes can all be illuminated by the same 100 or 150 watt shop-window luminaries ought not to need exploding. But just think of the audience participation and the arguments when it is put to the test!
Robert Weale



Christ Before the High Priest, by van Honthorst, and All the Lights, by Delvaux



Forum

Westminster scene

What's become of the fish

One of the points which has struck me forcefully about the European Parliament is how eloquent many of my new colleagues—particularly the younger ones—can be, and in tongues other than their own. None more so than the radical Dutchman, Laban, who can be marvellously persuasive inside the Socialist Group and in Plenary Session. And, it is Laban who is tackling the Commission about a problem which is coming to notice for the first time in Britain, after complaints by Scots fishermen, but which has worried the Dutch for some time—namely, the problem of diseases in fish caused by the growing pollution of the North Sea.

Laban asked the Commission to confirm that for some time now about half the fish caught by French fishermen in the North Sea around Calais have had to be declared unfit for human and animal consumption, because of the serious signs of disease apparent especially in cod and flat fish.

The Commission replied that they are aware that for some years past fish caught around Calais (The Flanders bank to be precise) have been displaying symptoms of disease, notably ulcers and tumours of either the skin or the mucous membrane. The proportion of fish affected varies from season to season, and from one fishing area to another, but would not appear, say the Commission, to be as high as 50 per cent.

Again, Laban asked whether it is true that the Fisheries Institute in Ijmuiden has not yet been able to determine the causes of these fish diseases, but is inclined to attribute them to growing pollution of the North Sea from discharges made by chemical industries on North Sea shores. The answer given by the Commission is that the institute has failed to pinpoint the cause of the disease, but that the oceanographic research vessel Talassa has completed operations in the area, collecting data on sediments and taking samples notably of plankton.

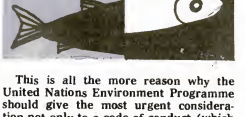
I gather from other sources than the Commission that the chemical industry is very much under suspicion, though I must say that the area of the chemical industry of which I have first hand knowledge, around Grangemouth, has spent vast amounts of money combating pollution in effluent, and has certainly satisfied the technical experts, who can form a professional judgement.

Furthermore I was impressed during a visit to a paper mill in Linlithgow to learn of the expenditure which it had undertaken in recent years to reduce impurities going into the River Avon (Forth) from over 2000 parts in a million to 300 parts in a million—and paper works were a major cause of effluent.

Because of the nature of marine pollution it is essential that joint action be taken, not only at national, but at community and international level. With regard to land-based pollution, the major source of marine pollution, the Commission made an active contribution to the negotiations leading to the adoption by member states concerned of the Paris convention for the prevention of pollution of the North East Atlantic from land-based sources.

On 3 March 1974, the Council, on a proposal from the Commission, authorised the Community to sign this convention which provides for the partial or total elimination of pollution caused by certain pollutants classified in terms of their toxicity, persistence, and tendency to bio-accumulation.

Logic and consistency argue in favour of a similar proposal to protect the Mediterranean, and other waters suffering from the dumping of waste. However, we have to face up to the fact that in a modern society, the waste from industries on which we all depend for our standards of living has to go somewhere, and that the rendering harmless process of waste in modern industry is an expensive policy.



This is all the more reason why the United Nations Environment Programme should give the most urgent consideration not only to a code of conduct (which they are doing), but also to the way in which governments of national states should not find that their peoples are penalised for being clean in relation to the world's resources, while others, with dirtier habits, reap trade advantages (which I think they are not).

★ ★ ★

With the possible exception of rates increases, there is no subject which is giving MPs so much cause for concern from constituents as the electricity bills which have started to come in. And this after the hottest summer in years!

I dread to think what will happen when customers receive their electricity bills after the winter, even if it is not too harsh. The Under-Secretary for Industry, Gerald Kaufman, has been talking about the most recent gains in efficiency in the use and conservation of energy, following technological changes in industry, and the saving of energy by the use of improved quality of materials for industrial production, which should be of interest to the industrial user of electricity, whose state of alarm about electricity bills is no less than that of the domestic user who comes to MPs. Kaufman tells us that by closer monitoring and control, a 2 per cent saving in refinery fuel costs can be made.

Similarly, he says, recent changes in the design of heat exchangers and semi-condensate valves have permitted substantial energy savings to be made; replacement of old ethylene cracking furnaces by more efficient ones and the use of flare gas recovery will also reduce operating costs considerably through energy saving. In the metallurgical field, improved natural gas burners and ceramic recuperators have also produced energy savings in steel making.

However, I am glad to learn that in order to understand more systematically the current pattern of energy usage, the Departments of Energy and Industry are jointly developing auditing techniques, as part of a broader energy conservation programme.

This should enable a more useful assessment to be made of the potential effects of technological change on the energy pattern, especially those relating to the use of new and improved materials. This is important, since at the end of the day, the important savings in energy will be made in industry, and only secondarily by you and me and other domestic consumers, who have to pay our bills.

Tam Dalyell MP

Washington view

Food for whom?

There is a lot of argument here about whether significant numbers of our impoverished citizens have been reduced to surviving on pet foods.

The evidence, one way or the other, is by the nature of the matter scanty and mainly anecdotal, since there is no way in the mass of being certain of the ultimate consumers of the large variety of pet food products that are routinely for sale in what are otherwise people food stores. Inquiring reporters can usually round up a social worker or two to testify to finding dog food in homes that are known to be dog-less, and from this comes the plausible conclusion that human inhabitants are the consumers.

There are also reports from grocers of pet food sales to be pathetic. Trying to dope the matter by comparing pet food sales and the number of pets is altogether unmanageable, since we lack a reliable pet census and lots of them, anyway, exist on people food, with occasional supplementation by pet food; with lots of others, however, the pattern is reversed, thus making arithmetical analysis a hopeless task.

In any case, it is safe to assume that at least some poor people are in such financial difficulty that they have been forced to the bottom of the food chain and are obtaining nourishment from food intended for animals. All right-thinking people quite properly deplore this as insufferable for a wealthy country with bountiful agriculture. And so it is, particularly in view of the emotional effects that the reduction to pet food must have on the spirits of people who already have a good deal to feel unhappy about.

What has not been publicly discussed

so far in the controversy over people and pet food is why our people food supply does not include a socially acceptable counterpart of the highly nutritious, relatively inexpensive, and tasty (we'll come to that) product that is so readily available under the label of pet food.

I come to the subject with extensive personal experience, derived from sharing a residence with a splendid labrador retriever, Walter, who feeding on a veterinarian-prescribed diet of commercially common dog meal—supplemented with occasional thefts of people food—has healthily swelled from 12lb to 80lb in seven months.

Noting Walter's phenomenal growth, I have taken an interest in the mainstay of his diet, and have noted that, at the cost of 27·5 cents per lb—roughly one-third that of the going price of mincemeat, and about one-eighth the price of beefsteak—it contains 21 per cent protein, about the same as red meat. From the ingredients label, I assume that this protein originates in "ground yellow corn, soybean meal, meat and bone meal [and] ground wheat." No doubt at least some of the meat is from cast off carcasses that have been deemed unfit for human consumption, but aesthetics apart, what's the difference if the end product is sterile? Furthermore, it contains ample quantities of fat and fibre, plus generous doses of virtually every vitamin and mineral known to man and needed by dog.

Quite plainly, it is splendid stuff for growing a mammal, and if deep in the cell structure, man differs from dog in nutritional need, I doubt that more than a sprinkle in or out of some compounds or other would be needed to make the difference.

As for taste, it is not the least bit worse than the nondescript stuff of one brand or another that many of us absentmindedly munch at cocktail parties.

How do I know this? I offer not only my own personal testimonial, but that of selected acquaintances, who, having provided their informed consent in this age of high concern over human experimentation, have cautiously nibbled a bit and then crunched down a handful. (It must be acknowledged that many persons gag at the prospect, apparently because they assume that a product intended for those with four on the floor must contain gruesome contents. Curiously, however, they usually do not refrain from ingesting assorted sausage products, which do, indeed, contain stuff on which any sensible person would gag.)

As for the sanitary aspects of the dog meal product, I can provide no scientific evidence, beyond the observation that the dog thrives on it, and no human taster in my round of experiments has reported any ill effects. To this might be appended a note concerning food colourings, which, though highly suspect as carcinogens, are widely present in human foods, but absent from many dog meal preparations.

Now, this is not an argument for humans to revamp their diets around dog meal. Rather, it is an expression of curiosity as to why the highly nutritious and inexpensive stuff described above is not available in products directly pitched at the human market. The fact that it does not resemble food fresh off the farm is no counter-argument. The breakfast foods that humans consume in vast tonnages are transformed by manufacturing processes so that they bear no resemblance to their original constituents. Who would guess that corn flakes have anything to do with corn (assuming that they do)?

It is indeed shameful that the poor are eating pet food. But it is even more shameful that the food industry, with its great technology and powers of persuasion, has not chosen to do for people what it so skillfully does for animals.

Dan Greenberg

View from the country

On solar roofs

Not being entirely convinced that solar-heated houses costing "only" £112 000 each (see *New Scientist*, 14 August, p 382) will become global best-sellers, I have been carrying on my own more modest attempts at solar heating.

Self and a good friend started work on our solar roof at 08.30 hours on 2 June of this year. By 10.00 hours we had removed the slates from our kitchen extension and knocked off the old chimney. The signs were propitious—with solar energy trickling through the clouds warming our hard-working backs and the prospect of a long hot summer to come. By noon we had virtually abandoned the project. The clouds thickened, the temperature plummeted, and a heavy blizzard ensued. As we struggled with freezing fingers to keep the worst out of the house with large flapping sheets of polythene, we cursed the idiots who dreamed up solar heating, alternative technology, and the energy crisis. We retired sulkily to spend the rest of the day drinking coffee in the moderately dry kitchen below.



Such trials, I suspect, are set us by the Heavenly Plumber above whose solar design system is so arranged to supply the Earth with copious amounts of energy distributed in a way which takes the utmost ingenuity to retrieve. But next morning he had clearly relented. By the end of the day we had covered the roof with chipboard, covered the chipboard with roofing felt with large sheets of corrugated aluminium running down to a plastic gutter which discharged through a waste pipe back into the house.

This being the third solar roof I have worked on, I am now something of a dab hand at your plumbing. By Friday we had re-plumbed the entire house and were ready to switch on. The water gurgled satisfyingly up from the 180 watt circulating pump, into a header pipe running along the ridge, squirted out through the tiny holes we had drilled in it, ran down the valleys in the corrugated aluminium, dripped noiselessly into the gutter, ran back into the house, filled up a top-up tank, ran from there through the indirect coil of a 30 gallon hot water-tank, and thence back into the pump.

Monday morning we fastened some hard-wood battens across the roof, and fixed ICI's Novalux—a clear corrugated PVC—over the whole roof. By chance the next day an Italian television crew turned up, and were able to witness the testing of one of Shropshire's first solar roofs on a cloudless June day. By noon the water was heated to 132° F—which is much too hot to bath in without adding cold. When we worked it out afterwards, we had built a 16 square metre solar roof for £50 in materials cost and about nine or 10 man-days of work. What do we get for our money?

One thing we've had all summer is copious hot water—more than we can use. Open solar collectors of this type run at around 40 per cent efficient, though that figure drops as they get very hot. Maximum solar input is something less than 1kW/m² in mid-summer, so we have been picking up around 5 kW at peak intensity. I suppose we have averaged over the past three months something like 10 to 15 kWh a day, or approaching 1000 to 1500 kWh over-all. At current electrical prices that is worth between £18 and £27.

What's more our solar collector turns out also to be a lunar collector. These past few weeks we have been taking our baths (in the yard, for the bathroom is still not built) at the end of the day. This causes an insurge of cold water to the hot cylinders. The device we have for actuating the pump—a box of electronics which compares the temperature of the roof with that of the hot water, and turns the pump on when roof is hotter than water, and off when water is hotter than roof—then gets confused between the sun and the moon. The incoming cold water is at about 60° F, and lately the air temperature in the evening has been well above that. Result: the solar roof runs in the moonlight. Very satisfying—but admittedly unusual for this climate.

But I am now convinced that single glazed trickle roofs are the best economic answer. At a materials cost of £10/m² they are far, far cheaper than commercially available panels, the cheapest of which, with no glazing at all, comes in at £15/m². Most of the others work out at two or three times that cost. Admittedly they may be marginally more efficient but when the cost is so much less, one can simply build a far bigger collector and hence end up with much more

energy. Also a solar roof is a roof, and can be used to replace the old and crumbling slate if need be. A solar panel is only a panel, to be strapped on to something else.

And how shall we do in the winter? My plumbing system is such that there are two copper cylinders, the first heated by the sun and acting as pre-heater for the second. Water in the second is topped up to the required temperature by an immersion heater in the summer, and by a solid fuel heater in the winter. Now what we people who live in the country (and mainly in the kitchen) need is a big cooking stove to burn wood which also heats hot water. Like an Aga or a Rayburn. Unfortunately those devices push out the same amount of heat into the hot water system regardless of its temperature.

So nothing would be gained from the solar system. We have settled for a thermostatically controlled Parkray stove. This heats the hot water, and four radiators, and every kWh of sunshine we pick up will be a kWh of solid fuel saved. For those interested in technicalities, any solid fuel boiler or stove will do, providing the draught is thermostatically controlled by a water-way thermostat. And it's high time Aga and Rayburn produced a model to run in conjunction with solar heating systems, for that would provide the best fuel economy available to a domestic user. They say it's going to be a hard winter.

Robin Clarke

Economics

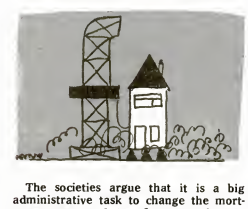
Time to buy a house

House prices in Britain have not shared in the inflationary boom of the past two years. On average, the price of housing has risen less than half as fast as other prices. However, it looks as if house prices are about to catch up in the next year or so. If you are contemplating a move, now is the time to do it.

As everyone now knows, house prices shot upwards in 1972 and 1973. In part this was due to an increased demand for private housing, reflecting a rapid increase in money incomes, a very substantial increase in the availability of mortgage finance, and perhaps a growing awareness that housing is a sound investment. At the same time the supply of housing increased at only a modest rate, after a decline in the number of houses started and completed in the 1969-1971 period. The inevitable result was a sharp increase in house prices—the average purchase price of dwellings rose by 31 per cent in 1972 and by a further 35 per cent in 1973. Although construction costs rose in this period, especially the prices of imported materials, house prices rose even more—only 10 per cent of the rise in the price of housing is attributable to the increase in building costs.

From late 1973 on, however, house prices have risen relatively slowly—by only 10·5 per cent in 1974 (when retail prices rose by 20 per cent) and by only 8 per cent in the year ending June 1975 (retail prices rose by 25 per cent).

The major responsibility for this dramatic cycle rests with the building societies, who typically provide about 85 per cent of new loans for house purchase. Basically, the amount lent on mortgage depends upon the amount deposited with the societies. This in turn rests upon the interest rate offered on deposits by the societies relative to competing institutions. Typically, the interest rate differential is about 2 to 3 percentage points in favour of the societies. However, when other interest rates change, the building societies are very slow to adjust the rates they offer, thus either squeezing or expanding the interest differential. Most mortgage contracts require three months' notice of a rate change.



The societies argue that it is a big administrative task to change the mortgage rates, and too frequent changes might discourage house-ownership. Consequently, in periods when interest rates are generally falling the building societies offer very attractive rates to the saver and hence attract lots of funds. Conversely, when bank rates are rising, the interest offered on shares and deposits with the societies is relatively low and savers switch funds to more profitable homes. In 1970-1972 when interest rates were generally falling, the building societies offered between 2½ per cent and 5½ per cent more than the banks to savers, who promptly switched their funds to the societies, and in turn these savings were on-lent in the form of mortgages for house purchase. But in 1973 and 1974, when bank rates were rising, building society deposit rates were left behind and net new funds available to the societies dried up. The result was the well-known mortgage famine.

In addition, however, the societies overlent in 1972 and 1973 in relation to their inflow of funds. Gross advances rose between 1970 and 1972 by nearly £1000 million more than the net increase in shares and deposits. The liquidity ratio of the societies declined from 19·1 per cent in 1971 to only 16·3 per cent in 1973. By 1974, however, when the cycle turned, the liquidity ratio was back to over 19 per cent.

The future course of house prices will also be determined by the interplay of supply and demand. One clue to likely demand is given by the average net mortgage payment implied by different average house prices and mortgage rates as a proportion of average disposable income. On the supply side, the level of house prices, the average mortgage as a percentage of the price, and the number of transactions, together determine the level of mortgage advances needed to satisfy the market. Whether these funds will be available or not depends upon the building society deposit rate relative to other interest rates and the level of personal savings (ie disposable income).

Over the period 1952-1971 (taking five year averages to smooth out the business cycle) the average mortgage varied between 65 per cent and 73 per cent of the average house price. During this period the mortgage rate rose from 4·7 per cent to 8 per cent. As a consequence the net mortgage payment (taking the split between interest and capital repayment that applied in the first year of a mortgage) rose from 14 per cent to 20 per cent of average disposable income. In the boom years of 1972 and 1973 the net mortgage/income ratio rose to 22 per cent and 27 per cent respectively, considerably above the historical "norm".

In the past two years, however, the mortgage has covered a very much lower proportion of the purchase price (about 60 per cent) and money incomes have risen much quicker than house prices. Consequently the share of mortgage payments in disposable income has now fallen from its 1973 peak. Indeed, if the mortgage were to return to two-thirds of the average house price, say £11 700 by the end of this year, the average net mortgage payment would be about £675 per annum (assuming the present 11 per cent mortgage rate). This, on the assumption of a 25 per cent mortgage/income ratio would be justified by an average disposable income of £2700 a year, ie today's figure.

It looks, then, as if the gap between current house prices and those that would be justified by present incomes, taking into account the mortgage rate, has been eliminated during the last two years. From this point on, then, house prices will tend to rise at least as fast as disposable incomes—say 8 per cent in 1976—and probably faster because of a secular long-run trend in favour of owner-occupation.

But what are the chances of the building societies receiving sufficient funds to meet this demand? The average income which would produce equilibrium in house prices grosses up to a total disposable income of about £70 000 million. This would finance the 600 000 transactions expected by the societies this year if their net receipts were just over 4 per cent of disposable income, say £250 million per month, compared to 3·5 per cent in 1974. This should be no problem. They should easily be able to attract this amount with only a 2 percentage points interest rate differential in their favour. At present the societies are stuffed with funds—net deposits have been running at the rate of £350 million a month this year—so they have some leeway.

All in all, house prices look set to take off again. Incomes will be high relative to mortgage outgoings, mortgages should be easy to come by, and interest rates will probably fall next year. Unemployment will rise, but not to levels such that housing takes a back seat. So don't wait; that house you've had your eye on could cost you 15 per cent more in a year's time.

Anthony Renton

Boston Notebook

Monopole marvels

I was delighted with the news the other week about the magnetic monopole. The notion that two years ago through a stack of film floating from a balloon over Iowa plunged a particle no one had ever detected before—despite searches that included the ocean floor and Moon rocks—and whose very existence has reportedly begun to be doubted by the man who first thought it up, gave me one of those frissons of pleasure known to all whose living is made from spotting and telling good stories, scientific or otherwise.

The tale is not a whit marred by all the caveats that have to be made about the need for confirmation. Indeed, they add to the joy of the story, giving the piquancy of uncertainty to the pronouncements of the theorists that the existence of a monopole means free quarks are out, Maxwell's equations become symmetrical at last after more than a century of lopsideness, and that quantum electrodynamics have to be revamped. Then, dammit, everything was spoiled. There in the press release accompanying the announcement, and running in an early paragraph of Walter Sullivan's New York Times account, was the assertion that the discovery of the monopole could lead to such applications as "new medical therapies in the fight against diseases such as cancer, and new sources of energy".



As the scientists' struggle for research funding becomes increasingly desperate in the era of diminishing resources, the code-words "cancer" and "energy" become increasingly ubiquitous and increasingly meaningless. Many biologists saw in the launching by President Nixon of his personal war on cancer two or three years ago virtually unlimited loot, and have been pillaging basic medical research funds ever since. It is, after all, the simplest matter in the world to write almost any biological grant proposal you care to name in such a way as to include in the opening paragraph a statement about how such-and-such will lead to new insights in the basic growth control processes of cells and thus to fundamental knowledge helpful in the relentless fight against cancer.

And you aren't really being untruthful. But you aren't being entirely truthful, either, and the commonly-held cynical attitude that you may as well take the money and run with it while its there is undoubtedly storing up dangerous repercussions in the future when payment in forms of results comes due. There are already rumblings in the United States that the creditors are checking their bills, and don't like what they see.

For a couple of years, physical scientists were very jealous of their biological colleagues access to the cancer bankroll. Then along came the energy crisis. The same scramble to recast research proposals and newspaper handouts then followed, with everything in the world of chemistry and physics now suddenly illuminating the fundamental nature of matter and/or energy, and so of possible long-term importance in the solution of the crisis in energy supplies.

But surely the monopole announcement takes the grand prix so far in arguing for potential practical applications of a basic research phenomenon. I can't remember, for instance, both cancer and energy being cited before, and to do so on the basis of a single particle track that may or may not reveal the existence of an entity that in any case is clearly not exactly commonplace strikes me as the most blatant hyperbole. I tried to discover the basis of the claim, and was treated by an American Institute of Physics press spokesman to fiendishly convoluted series of ifs and perhapses and maybes. His main point was that people expected you to be able to say what use a discovery might be and he was simply doing the best he could. I liked far better the droll suggestion of P. Buford Price, one of the co-discoverers, that "you might drive ships across the seas by putting a few monopoles in the ship and having the Earth's magnetic field tug it across the ocean". That's the sort of silly answer to a silly question that science could do with more of, rather than pompous, insincere and ultimately damaging platitudes about cancer and energy.

★ ★ ★

Last week a Russian ship steamed into Boston Harbour carrying a West German undersea habitat due for emplacement this week on a rocky ledge 10 ft underwater off the picturesque fishing port of Rockport, the St. Ives of Massachusetts, a unique underwater scientific collaboration between the United States, Germany, the Soviet Union and Poland, bearing one of my all time favourite acronyms, FISSHH (for first International Saturation Study of Herring and Hydroacoustics). The project will involve teams of scientist-aquanauts spending most of the autumn studying close-up the spawning habits of the herring—important to the North Atlantic fishing fleets of all four nations—and testing sonar devices that will allow the identification of schools of fish from the surface. It all sounds like a lot of fun and useful too and if everything goes according to plan it will be brought to your television screens in living colour early next year, courtesy of the BBC.

Graham Chedd

Out and about

Strictly for the record

For weeks, you may recall, there had been next to no rain throughout most of the country and then on Thursday, 14 August, some ominous-looking anvils of blue-black cumulo-nimbus began to build up over Hampstead Heath. At precisely 5·25 pm on that day they seemed to explode. At the height of the storm, cloud-to-cloud and cloud-to-ground forks of lightning flashed at intervals of about 15 seconds. During less than three hours of incessant rain, the gauges of the Hampstead Scientific Society's weather station registered 6·72 inches. In terms of hourly rainfall this surpasses a British record of 11 inches which fell during a 24 hour period at Martinstown, Dorset, in 1955. The London Weather Centre cannot find a precedent for the inundation.

Within half an hour, the four rivers that rise on the heights of Hampstead—the Fleet, the Tyburn, the Westbourne and the Brent flash-flooded and the peripheral district below sustained material damage reckoned at over £1 million. Quite apart from the prodigious quantity of rain that fell, the marvel is the localisation of the storm.

Writing with the authority of hindsight—and innumerable tales from neighbours—I recall plainly how, walking on the heath early that morning, the hard pan of clay, in places heavily eroded, felt warm to the touch. The sultry breezes raised micro-vortices of swirling dust devils that scuttled about like crabs before subsiding. It felt cooler inside the apartment than out.

The build up took place over a matter of five or six hours until tremendous convection currents rose aloft from an area only some 900 acres in extent, but still the highest in London. The rain and the hail stones barrelled down. There are hazards in living on the flanks of what used to be an estuarine swamp, and though I have experienced many tropical storms, I can't recall one that matched the violence of that wet evening. At times there seemed to be no visible lines, no rods of rain as you normally see them. It fell in misty sheets with a noise like boiling fat.

With only one or two exceptions, the national press treated the matter lightheartedly, for some an excuse to print pictures of girls wading through crotch-deep water, holding their skirts up. Fortunately, our local paper, the *Ham and High* is possibly the best in the country. Gerry Isaaman, the editor, promptly mustered his staff and brought out a storm issue which became something of a collector's piece. There isn't a copy left. In it there is the substance of a composite history on the lines of *The Bridge of San Luis Rey* for almost everyone on their way back home to north-west London that night has a flood story to tell.

The man downstairs says when the Bakerloo drew up into West Hampstead, to everyone's surprise a flood of platform-



high water poured in when they opened the doors. It took him half an hour to wade to a pub about 400 yards away. In there he heard a woman telephoning her husband in Nottingham, "I know it sounds silly, dear," she said, "but the car's in the pond, right over the wheels. I'm not sure where I am, but it can't be far from Potter's Bar." Another observer recounts how a cataract poured into the Gents and out through the Ladies. A circular sewer cover blew up and for a few seconds hung suspended, like a ping-pong ball on the jets of a shooting gallery.

By far the worst tales are of hundreds of uninsured families who sustained not merely four or five feet of water in their living quarters, but soup-thick sewage which has left many places still untenable. Blankets and clothing were re-distributed among tenants as in the days of the air raids. The torrents brought chaos to the roads, the railway service and the telephone system. They found one man dead in his flooded flat. A couple on the Heath were struck by lightning. Though burned and temporarily paralysed, the man (58) said he remained wholly conscious. He could have told you the time. His most vivid impression was the "intense smell of burning". His woman companion (45) had to be admitted to the intensive care unit of the local hospital. She has recovered, but can't recall anything after they sought shelter under a tree.

It looks now as if, long before the storm burst, sectors of the local sewage system were overloaded with silt which, had been washed off Hampstead Heath and yet there are still reactionaries on the local protection society who complain about the jungle of vegetation which holds the meagre soil together.

John Hillaby

The last word on . . .

Topless tournament

It may be welcome news to all gentlemen who now spend money to view the unclothed chests of strip-tease ladies, topless barmaids, and quivering go-go girls that the day may not be far distant when they will be able to satisfy their mammary curiosity by just going down the local supermarket. Already, in France, as reported by the *Guardian*, an opinion poll has indicated that "76 per cent of the French population is no longer shocked by the sight of bare breasts in public." A finding which claims current support from the fact that "There is so little fear of the law or public opinion this year that in coastal resorts housewives can be seen shopping wearing only the briefest bikini pants."

There are, of course, a few small bastions of traditional morality still fighting a rearguard battle against such wholesale unveiling of the female thorax divine. For example, a deputy in the French National Assembly has asked the Minister of the Interior to close the nearby swimming pool, which is in view of the Chamber, because he claims that the mademoiselles who have there been indulging in topless sunbathing were outraging the dignity of Parliament. It cannot be confirmed that the minister told him that if he kept his eyes on the order paper instead of the window overlooking the swimming-pool, much benefit might redound on his constituents. While back at home, in Haverhill, Suffolk, the local angling club has complained to the Council about nude women bathing in the lake where they pursued their piscatorial pleasures, on the accusation that such naked aquatics would prevent the fish from breeding.

Whereas, to the ordinary ichthyologist in the street, it would seem more likely that the sight of fair, bare women swimming overhead would be so titillatory as to turn the mind of even the most immemorial carp towards mad, passionate spawning.

However, fear not, mes voyeurs, that these minor pockets of resistance will halt the delicious advance of the monokini. Its minimal wearing has already been legalised by the authorities of 19 major French seaside resorts and is shortly to be permitted in Parisian open-air pools. And at the Riviera resorts of Juan-les-Pins and Antibes, positive encouragement is being given to the exposure of nubile bliss by the official award of "Cote d'Azur Diplomas of Bodily Beauty" to exceptionally well endowed ladies.

A male jury has been appointed, presided over by an army major, who have the delectable duty of sitting on the beach all day and watching out for exciting bosoms. Whenever they see an outstanding pair, they issue the lovely owner with a diploma, with marks ranging from "very honourable" to "absolutely exceptional."

In the hope that the gallant major may invite me to join his happy jury, I can assure him that I too have had military experience of scientific bust-judging and would offer him the use, without payment of royalties, of the British Army busty substances scale.

This was constructed during a wartime sojourn in an army hospital in Tunisia when, to while away the overheated hours, the leading lights in the ward decided to compile by popular vote, a league table of the nursing sisters placing them in order of the beauty of their bosoms. Score cards were given to all patients and each little ministering honey was watched by all eyes as she bustled about the beds, and marked meticulously for size, bounce and curvature.

Those among us experienced in such matters advised that the British female frontage came in two distinct fruity varieties—the luscious melon and the graceful pear; the first being classed as "boopers," and the second as "droopers." The ogling jury of Antibes may wish to note that we therefore had an ascending scale of Droopers, Boopers, Super-Droopers, and Super-Boopers; and a descending scale of Nubbins, Sub-Nubbins and Elephant's Ears. When all the score cards were in, it was found that the championship went to the Matron who carried her gorgeous all before her with the ramrod carriage of Queen Mary and the outstanding rank of Super-Dooper-Boopers.

Objections were raised by some inmates who were in love with lesser nurses on the grounds that the All-Highest might be wearing a padded bra. But, although there was at least one budding VC in the ward there was nobody who could summon up the courage to attempt so sacrilegious a check.

And I will have to stop now because the Women's Lib brickbats are already coming through the window and Germaine Greer is on the telephone to say that it's now definitely all off between us for next weekend.

Patrick Ryan

Tantalizer

No. 416 Prior arrangements

"This being Wakes Week," announced the Prior, "I have devised a bit of fun. I shall now paint a red or blue blob on the pate of each of you for each of the others to see. There will be more red than blue but there will be at least one blue. Each of you is of course a perfect logician and each of you must try to discover your own colour by logic alone. You follow me?"

Eleven tonsured heads nodded gravely and the Prior continued, "On the first stroke of the Compline bell anyone who has already discovered his colour shall leap loudly into the middle of the cloisters for the others to see." The brothers dispersed and on the first stroke of the bell no one moved a muscle. But when it sounded 24 hours later, an odd number of monks sprang out and cavorted in the cloisters.

How many pates had the Prior painted blue? *Martin Hollis*

Solution to Tantalizer No. 415 Dizzy spell 924

On an empty 7×7 grid write 1 in the bottom left corner square and the two adjacent ones. Now, starting with the cell diagonally up from the corner cell, write in each cell the sum of the numbers in the next cell below and the next cell to the left. (Edge cells on bottom and left have 1). You will end up with 924 in the top right corner.

★ ★ ★

Apologies to frustrated solvers. First paragraph of No 413 should have ended: "If you were wholly right you collected £10. If you got two events right you collected £4. If you were right about the javelin only, you collect £2. Otherwise you lost. In No 412: "Junior G thought exactly eight others would want to *convict*".

Letters

Top twenty

Sir,—In order to correct a certain amount of misunderstanding that has arisen from the alphabetical listing of scientists in Table 3 of "Scientists and their Images", (28 August, p 473) we list below the "Top Twenty" in order of frequency of mention by respondents to the opening question of the "Scientists Scrutinised" questionnaire (8 May, p 313).

The last column gives the frequency of response as a percentage of all those who listed "named people" in reply to this question.

1	Einstein	19·2	10	Archimedes	1·8
2	Newton	10·2		Professor Branestawm	1·8
3	Bronowski	5·4		Galileo	1·8
	Pasteur	5·4		Fleming	1·8
5	Rutherford	4·2		Sir G. Porter	1·8
6	Magnus Pyke	3·6	15	Marie Curie	1·2
7	Darwin	2·4		Fermi	1·2
	Faraday	2·4		Sir F. Hoyle	1·2
	Sir P. Medawar	2·4		Pauling	1·2
				John Taylor	1·2
				Barnes Wallis	1·2

Fifty-two other names were mentioned by respondents.

We hope this information clarifies who's who in the listing but advise that its significance is not taken too seriously.

Michael Shallis
Department of Astrophysics
University of Oxford
South Parks Road
Oxford OX1 3RQ

Nuclear economics

Sir,—Mr Knight and Mr Rhys Jones, (Letters, 31 July, p 288) raised several questions in relation to the interview with Sir John Hill reported by Michael Kenward ("New start for Britain's nuclear programme," 17 July, p 158).

I will take first Mr Knight's charge that nuclear decision making is not subject to independent examination and public accountability. The nuclear power programmes have been the subject of the closest scrutiny by Ministers and Parliamentary Committees and have been debated at length in Parliament itself. The issues have been fully reported and debated in the press and on television.

His second point—why order new plant when present reserve capacity seems to be ample?—is primarily a question for the Generating Boards. I would however remind him of his own references to the long timescales of ordering, building, and commissioning large modern power stations.

Next, I would like to take together Mr Knight's reference to the arguments that have been advanced about the energy balance of nuclear power, and Mr Rhys Jones' plea for keeping energy options open. The countries that look to nuclear power to meet an increasing proportion of their demands for energy are providing themselves with an important new fuel option that will greatly relieve the pressure on the world's limited fossil fuel supplies and thus improve their own prospects of a continning supply of fuel for those purposes (such as transport) for which it is especially suited.

Contrary to the impression given by the Friends of the Earth, these plans give rise to no energy-balance problems. It is only by adopting unfavourable energy accounting conventions and assuming the maintenance of absurdly high growth rates that a hypothetical energy balance problem can be illustrated. In practice the growing use of nuclear energy will save very large quantities of coal and oil that would otherwise be burned in power stations.

There are in general no significant differences between the times taken to build and commission nuclear and conventional plant. Nuclear plant costs more to build (the figures quoted by Mr Rhys Jones overstate the difference, partly because they cover different periods) but the extra cost is much more than offset by the low running costs of the nuclear plant. In accounting terms the return on the extra capital invested in the nuclear plant is very high indeed. It is because nuclear fuel costs are so low that even the relatively low thermal efficiencies of the early Magnox nuclear stations fail to dislodge them from their place at the top of the list as the lowest-cost producers of electricity.

It is true that uranium and some other special materials used in nuclear plant are imported from overseas, but there are reasons why we may nevertheless regard nuclear power as being a substantially secure source of energy. The physical quantities of material imported (as uranium oxide for enrichment in the UK) are small in relation to their energy content, so large amounts of energy are readily stockpiled; and the plutonium and depleted uranium rejected from the thermal reactor fuel cycle constitute a very large indigenous stock of fuel for the fast reactor in due course.

Mr Rhys Jones appears to have misunderstood the last paragraph of Michael Kenward's article. The point of this paragraph was that the more articulate critics are concentrating attention on the purely hypothetical problems of nuclear energy while the real problems are those of practical engineering. The hypothetical problems are not being ignored but many of the critics have the priorities out of perspective. Labelling hypothetical problems "strategic" does not make them any less hypothetical.

L. G. Brookes
United Kingdom Atomic Energy Authority
11 Charles II Street
London SW1Y 4QP

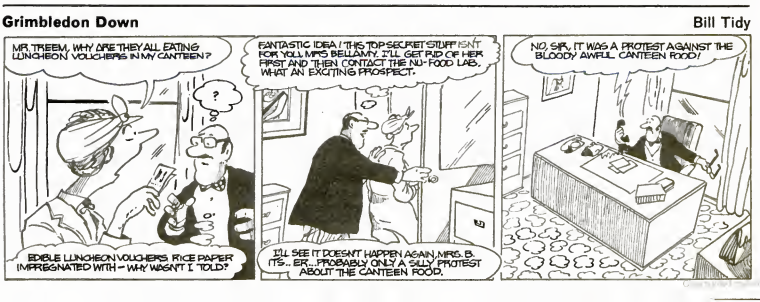
Gamma cameras

Sir,—With reference to the article "Smoothed gamma rays detect cancer sooner than X-rays" (Technology review, 21 August, p 433) we should like to clarify a few misleading points in the article.

The first sentence probably arose due to a misunderstanding. We did in fact state that in our opinion no less than half the conventional gamma cameras in Britain and the United States will be

Grimbledon Down

Bill Tidy



computerised and some radiographic work transferred to these systems in the next 10 years. The colour display is not the most advanced feature of our system, more, in fact, a convenient way of displaying a colour matrix. Also there are 16 different colours available rather than eight. The smoothing of original data is in fact one of the less complex filters employed by the computer and by no means the only operation performed by the system. Varian supply only the computerised data handling part of the system, not the camera.

R. W. Kenny

Varian Associates Limited
Molesey Road
Walton-on-Thames

Live mnemonic

Sir,—Mr G. Needham (Letters, 28 August, p 501) asks for a mnemonic to aid memory of the colour code for commercial electric wiring. Is this what he is seeking?

Red-blooded he-man, he's a real *live wire:*

His colour signals Danger! Stop! and Fire!

Blue-water sailor must surely *neutral* be—

If he would meet no foe while on the sea.

Yellow-livered coward, with nasty streak of *green:*

He cringes on the *ground*, not wishing to be seen,

Or burrows in the *earth*—if you follow what I mean.

The association of red with blood and life, blue with politically neutral oceans, and yellow with cowardice and cringing on the ground seem natural enough to recall without effort. "Ground" is used in America for our "earth".

Walter Shepherd

The Corner House
Maiden Bradley
Warminster
Wiltshire

Writing and printing

Sir,—While I agree with Mr Uffen (Letters, 7 August, p 346) that there is a good deal of inefficiency built in to our present methods of translating material from manuscript to book form, I entirely disagree, as a printer and publisher, with his proposed methods of improving matters.

From my experience with a little training most authors find it faster to produce a typewritten manuscript than a handwritten one, so rather than do away with typewriters I would suggest that an author can put an end to his typist's misery (if it such) by typing his manuscript himself rather than producing it for the printer in longhand. This is not to suggest that the typewriter should take the place of handwriting, but my second point is that in general it is far easier for a compositor to follow a well-produced typescript, and for this reason handwriting should be kept for the initial drafts of a work.

Another obvious advantage of the author producing his own final typescript for setting is the reduction to a minimum of the number of proof corrections necessary after the copy has been set. Although it has been said so many times before the section on this topic in the *Writers and Artists' Yearbook* is well worth reading on this topic) so many authors return proofs with copious alterations which should have been made long before the copy was typeset, and then wonder why both the cost of setting and the time taken to produce corrected proofs have increased so much. It must be the author, and not the printer, who is responsible for spelling, punctuation, grammar and accuracy; although I have not yet met a scientific author to compare with the couple who, when wanting wedding hymn-sheets printed, asked me what hymns I thought they ought to have in the ceremony!

John Button

Thuleprint Limited
Compass House
Sandwick
Shetland Islands

Indices

Sir,—I have a fellow-feeling with Al (Review, 28 August, p 499) and others who have suffered from inadequate indexes. But it is a chore—I write as one who has done his share of index compilation in a technical field—which is seldom most completely done by the author who, being fully conversant with the matter, often cannot see that an index is necessary and is bored with the whole thing anyway! The problem is nothing new, however. I treasure a memory of an index in a book over 100 years old—it must, I think, have been one of those Victorian compilations of entertaining and improving, but useless, facts—in which a piece headed "Remarkable waterspout off Java" was listed alphabetically under "remarkable", and *not* "waterspout" or "Java".

D. L. F. Sealy

Flat 5
69, West Hill
Putney
London, SW15 2UL

Sir,—Reading Kenneth Mellanby's letter (4 September, p 554) reminded me of a quotation from John Baynes (1758-1787) which prefaces the index in William Hayes's *The Genetics of Bacteria and their Viruses* (Blackwell, 1964):

"The man who publishes a book without an index ought to be damned ten miles beyond hell, where the Devil himself cannot get for stinging nettles."

I should like to think that John Baynes would also have agreed that the frustration of trying to use a skimpy index often leaves the reader wishing the publisher a fate worse than stinging nettles—well done Al!

John Muggleton

32 Penton Road
Staines
Middlesex
TW18 2LD

electronic instruments exhibition

London and Bristol

Bloomsbury Centre, W1
23-25 September 1975

Bristol Esso Hotel, Filton Road, Hambrook
30 September–2 October 1975

The Electronic Instruments Exhibitions are organised on behalf of the Electronic Promotion Group in co-operation with the publication 'Electron'.

They bring together many of the leading electronics manufacturers of the United Kingdom and give you an excellent opportunity of seeing the new equipment and talking to the people who produce it. Don't miss the EPG show near you.

Admission is free.

EPG

London Show open from 09.30 to 18.00 daily (09.30 to 17.00 on the final day).

Bristol Show open from 09.30 to 18.00 daily (9.30 to 17.00 on the final day).

Send for brochure of either show (includes exhibitors and product list) to the Electronic Instruments Exhibition, Industrial and Trade Fairs Limited, Radcliffe House, Blenheim Court, Solihull, West Midlands B91 2BG
Tel: 021-705 6707 Telex: 337073
Cables: Indoffo Sol

CLASSIFIED ADVERTISEMENTS

LINE RATE 85p per line **CM RATE** £4·05 per single column cm

Advertisements received first post Monday will be published the following Thursday
If proofs are required; copy should be sent 8 days prior to publication date

Advertisements should be addressed to
Classified Advertisement Manager
NEW SCIENTIST
128 Long Acre, London, WC2E 9QH.
Tel: 01-836 2468 Telex: 27253

APPOINTMENTS AND SITUATIONS VACANT

CRANFIELD
Photofabrication Research
A POSTDOCTORAL RESEARCH OFFICER

is required in the Manufacturing Technology Group of the School of Production Studies at Cranfield, to establish the present state of the art and assess the potential market for this technique. He will investigate the etching process and factors such as photoresist adhesion, etchant composition and methods of application.

This is a 3-year project, supported by the Science Research Council and Industry, in a new area of technology and may be of considerable importance as a production technique in the future.

Applicants should have had several years industrial experience in the use of etchants, also academic qualifications in chemistry and physics.

The applicant must have enthusiasm and persistance, in order to be successful with this research, but should find the work absorbing and interesting.

Salary within a range rising to £3022 pa (under review), plus superannuation benefits.

Application forms may be obtained from The Secretary (Appointments), Cranfield Institute of Technology, Cranfield, Bedford, MW43 0AL, quoting reference 548.

INFORMATION SCIENTIST REQUIRED BY LEATHERHEAD FOOD R.A.

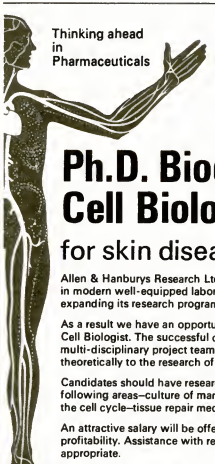
A vacancy has arisen in the legislation section of the Information and Library Department. This is an important post in a section with a world-wide reputation for the high standard of its legislative advice. The post itself calls for accuracy and the ability to give advice which is clear and unambiguous. The successful candidate would be in his/her late twenties and would possess a degree in one of the scientific disciplines. A few years' experience of the food industry and/or similar type of work would be an advantage. Flexible working hours in operation. Fringe benefits include Superannuation Scheme and Staff Restaurant.

Please apply to: Miss A. Millidge, Information Officer, Leatherhead Food RA, Randalls Road, Leatherhead, Surrey, KT22 7RY.

NORTH LONDON BLOOD TRANSFUSION CENTRE

A vacancy exists for a JUNIOR TECHNICIAN of high quality. The successful applicant will receive training in all aspects of blood group serology with day release where applicable. Salary on Whitley Council Scale plus £312 London Weighting Allowance.

Apply in writing to The Director, North London Blood Transfusion Centre, Deansbrook Rd., Edgware, Middx. HA8 9BD.



Thinking ahead
in
Pharmaceuticals

Ph.D. Biochemist/ Cell Biologist

for skin disease research

Allen & Hanburys Research Ltd., a member of the Glaxo Group, located in modern well-equipped laboratories at Ware in rural Hertfordshire, is expanding its research programme on skin diseases.

As a result we have an opportunity for a post-doctoral Biochemist or Cell Biologist. The successful candidate will become a member of a multi-disciplinary project team and will contribute practically and theoretically to the research of the group.

Candidates should have research experience in one or more of the following areas–culture of mammalian cells and tissues – the control of the cell cycle–tissue repair mechanisms.

An attractive salary will be offered plus a bonus based on Group profitability. Assistance with re-location expenses will be given, where appropriate.

Please write, quoting ref. AQ.563, giving brief details of career to date and present salary to

G. R. Jones,
Personnel Officer,
Allen & Hanburys Research Limited,
Ware, Herts. SG12 0DJ.

Allen & Hanburys
MAKERS OF FINE PHARMACEUTICALS

SECRETARY

The advertisement managers of The Geographical Magazine and New Scientist are looking for a secretary, over 21, with accurate typing. Shorthand desirable but not essential.

Must have good telephone manner.

Salary £45.40 per week. Four weeks holiday after a year.

Please telephone Steven Goldsmith or Roy Edwards on 10 836 2468.

CITY OF LONDON POLYTECHNIC
Department of
Biological Sciences

The Biology Department requires a Grade 4 Technician to be responsible to the Laboratory Superintendent for the organisation and maintenance of the departmental stores. Duties will include preparation of orders, keeping records, checking deliveries, issuing materials and equipment, and checking stocks.

Candidates should have appropriate qualifications.

Salary £2247-£2628 plus £411 London Allowance.

Apply to Head of Department of Biological Sciences, Calcutta House, Old Castle Street, London E1 7NT.

Wellcome

The Wellcome Research Laboratories
BECKENHAM

Physiologist or Pharmacologist

with Post-Doctoral experience

There is a vacancy in the Biophysics/Biochemistry Department of the Wellcome Research Laboratories for a scientist with experience in the physiology or pharmacology of excitable tissues. Applicants should have had at least one year's post-doctoral experience.

The laboratories are situated in pleasant parkland surroundings within easy reach of Bromley and Beckenham and about 12 miles from Central London. Conditions of employment are attractive and include 4 weeks' holiday, subsidised canteen, excellent sports and social facilities and assistance with re-location expenses where appropriate.

Please write, giving brief details of background and experience including a list of published work in this field, to the Personnel Manager, The Wellcome Research Laboratories, Langley Court, Beckenham, Kent BR3 3BS. Applicants are also asked to indicate the earliest date on which they could join the Department.

Technician for Reproductive Toxicology Research

Huntingdon Research Centre is the UK's largest life sciences research establishment and a world leader with a major share of the world's contract market. Our facilities and resources are second to none.

The Department of Reproductive Toxicology has an international reputation. To meet increasing demands for its services, we now need a Technician who has had experience in the examination of compounds for possible teratological activity. You should preferably have ONC, and there will be all the opportunities you need for further education and excellent career prospects in this rapidly expanding field of research.

Salary is attractive and benefits include pension, subsidised restaurant and an active sports and social club. The location itself has many advantages: Huntingdon is situated in pleasant countryside, and housing prices are among the lowest in Britain.

For more details and an application form, phone or write to: Nancy McCree, Huntingdon Research Centre, Huntingdon PE18 6ES. Tel: Huntingdon 890431.

HRC

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE
Incorporating the Ross Institute
(University of London)
Keppel Street, WC1E 7HT

SAFETY OFFICER

Applicants are invited from suitably qualified and experienced persons for the post of Safety Officer, to co-ordinate and control safety matters in the School. He should preferably have worked in microbiological and/or biochemical laboratories and in animal houses, and be thoroughly conversant with modern safety techniques, the transmission of infections and relevant legislation. Suitable in-service training will be given in special fields, e.g. radiation hazards.

This is a senior appointment, for which a commensurate salary will be paid in the range £2778-£6050, in accordance with qualifications and experience. A London Allowance of £399 is payable throughout. USS. Applications, consisting of full curriculum vitae and naming two referees, should be submitted to the Dean at the School by 30 September, 1975.

BUREAUTECH
(SCIENTIFIC STAFF AGENCY)

Top jobs for ONC/HNC/HND/AIMLT/BSc. (Chem; Phys; Biol; Med. Lab. subjects)

We find you the job free of charge
Tel: 01-959 3517.

Natural Environment Research Council

ANTARCTIC EXPEDITION

AN

Observatory Physicist

is required for service at British stations in Antarctica. The tour of duty covers two Antarctic winters involving an absence from the United Kingdom of about 2½ years. The successful applicant will be required to work on his field data for up to a year after his return.

Qualifications: preferably a First or Upper Second Class Honours degree but an ordinary degree with experience or appropriate HND will be considered.

Starting salary from £2012 per annum rising in scale to £3121 per annum. Low income tax, free messing, bonus for satisfactory service.

Applicants must be single and aged 22-30.

Please write for further details, stating full qualifications to:
The Establishment Officer
British Antarctic Survey,
2, All Saints Passage,
CAMBRIDGE CB2 3LS.
Please quote reference BAS 3.

UNIVERSITY OF SUSSEX
School of Biological Sciences
GRADE 3
RESEARCH TECHNICIAN
in the Biochemistry Group from 1 October, 1975.

This post is supported by the Cancer Research Campaign and is for a period up to the end of September 1976, in the first instance, with the possibility of renewal for a further two years. Experience in Biochemistry techniques and, in particular, tissue culture work desirable.

Salary within the range £2013-£2343 per annum, depending on age and experience.

Sixteen days holiday, plus University closures at Christmas and Easter. Superannuation and sickness benefit schemes. Hours 8.00-5.00 p.m. 5-day week.

Applications in writing to the Laboratory Superintendent, School of Biological Sciences, University of Sussex, Falmer, Brighton BN1 9QG.

JUNIOR TECHNICIAN

required for approximately two years for a research project in the Department of Chemical Pathology. Apply in writing, stating age and giving details of education and experience (if any), to the **Secretary, Guy's Hospital Medical School, London Bridge, SE1 9RT,** quoting **Ref. C.H.2.**

CHIEF OR SENIOR PHYSIOLOGICAL MEASUREMENT TECHNICIAN

HYDE PARK CORNER

Due to the expansion of the establishment in our Cardiac Department, a Chief or Senior Technician is required.

Suitable candidates are required to have experience in routine electrocardiography and cardiac catheterisation and there will be an opportunity to gain experience in echocardiography, phonocardiography and theatre monitoring for cardiac surgery.

An interest in the supervision of equipment would be an advantage.

Hospital accommodation for temporary period will be made available for the successful applicant, if so required.

The salary per annum (inclusive of London Weighting) is on the scale £3042–£3768 for a Senior Technician and on the scale £3870–£4893 for a Chief Technician.

For further information, application form and job description, please write to or telephone Mr G. Deasy, Assistant Hospital Secretary, St. George's Hospital, London, SW1X 7EZ on 01-235-4343, Ext. 177.

St Georges Hospital SW11

Wandsworth & East Merton Teaching District

CRANFIELD INSTITUTE OF TECHNOLOGY

has vacancies for a

TECHNICAL OFFICER

and a

TECHNICIAN

in the Environmental Sciences Research Unit to join a team concerned with all aspects of instrumentation and data recording in laboratory and site experiments. Current activities include measurement of engineering parameters; noise, vibration, turbulence, stress, temperature on industrial installations; and of meteorological variables; wind, humidity, radiation in field and laboratory environmental studies.

Salaries according to qualifications and experience within the University Technical Staffs salary grades, which are currently under review.

TECHNICAL OFFICER: Qualifications preferred HNC or full C and G certificate in Electrical or Mechanical Engineering. Experience of strain gauge techniques would be an advantage. Salary grade 3 (£2439–£2895) p.a. or exceptionally, grade 6 (£2844–£3450) p.a.

TECHNICIAN: Appointment is initially limited to two years. Qualifications performed ONC or C and G technician certificate in electronic, electrical or mechanical engineering. Salary grade 4 (£2247–£2628) p.a.

Application form from Staff Records Officer, Cranfield Institute of Technology, Cranfield, Bedford, MK43 0AL. For further information telephone or write to Guy West (Tel: Bedford 750111 ext. 570/1.)

"As a teacher– I wanted to broaden my experience"

Education Officer, BSc, ARCS. 28. Flight Lieutenant.



"If you spent years getting good qualifications and end up as I did, in a narrow specialisation, you can understand why I wanted wider experience. This, plus the chance of advanced study, turned my thoughts to the RAF."

"I've taught more subjects; each is organised in a very practical, clear-headed way. For instance, you might think you couldn't teach electronics without a lot of background maths. But you can – and very effectively, too!"

"Away from the classroom? How about Scotland, Exmoor, Dartmoor, taking boys on expeditions for the Duke of Edinburgh awards?"

"They asked me to design the training syllabus for a new trade – electronics fitters for flight simulators. It was a 6-month job. I had an engineer officer to help me. We assembled a 9-man committee from all over the RAF and produced a 100-page paper recommending a 56-week course."

"Apart from my officer training – a 3-month tutorial course on a subject of my own choosing – transistor circuitry; a two-week outdoor activities course; and, in the immediate future, a 12-month MSc course in microwave communications. All in about 4½ years.

And I've changed my Short Service Commission for a Permanent Commission."

"It all began when I saw an advertisement."

If you are interested, post coupon now to Group Captain H. E. Boothby, OBE, BA, RAF, Officer Careers (609MP2), London Road, Stanmore, Middlesex, HA7 4PZ.

Please send me information about officer careers in the RAF Education Branch.

Name _____

Address _____

_____

_____

(Formal application must be made in the UK)

Date of birth _____

(Upper age limit 30)

With this coupon please enclose, in confidence, a brief *curriculum vitae*. You should be a graduate, qualified to teach mathematics, engineering or a science subject.

RAF officer

West of Scotland Health Boards

Department of Clinical Physics and Bio-Engineering

PHYSICISTS AND ELECTRICAL ENGINEERS

Posts are available at Basic Grade level for new or recent graduates in physics or electrical engineering. Applications will be welcomed from persons holding degrees with first or second class honours or higher degrees. The successful candidates will be allocated to e systematic training programme or to research projects (with the opportunity of working towards higher degrees) or to other duties appropriate to their qualifications and experience.

Salary will be on the scale £2706–£3933 per annum with placing for approved experience since graduation. There are prospects of promotion to posts carrying salaries of over £10 000.

The Department of Clinicel Physics and Bio-Engineering which serves Health Boards in the West of Scotland, has e staff of over 200 end is the largest organisation of its kind in the world. The posts now vacant offer excellent opportunities for important work neer the boundaries of knowledge in fields of activity which are socielly important end scientifically exciting. All posts carry superannuation benefits end generous leeve allowance.

Application forms end further pertículers may be obtained from the **Director, Department of Clinical Physics and Bio-Engineering, 11 West Graham Street, Glasgow, G4 9LF,** to whom completed applications should be sent before 3 October 1975.

UNIVERSITY OF LIVERPOOL
Sub-Department of Geophysics
TECHNICIAN

required to assist with the day to day running of apparatus including equipment to determine the ages of rocks. Applicants must be over 25 years of age and hold at least an ONC or equivalent. 'A' level Chemistry useful. Training will be provided but experience of vacuum equipment and mass spectrometers would be advantageous. Salary within a range up to qualifications and experience, which must include several years technical experience. Application forms may be obtained from the Registrar, The University, P.O. Box 147, Liverpool L69 3BX. Quote ref. RV/581/NS

GLAXO
HNC/HND
to work on
Applied Immunology

A recently qualified technician is required by Glaxo Research at Greenford to work on current topics concerned with the medical aspects of applied immunology. Candidates should have an HNC or HND in an appropriate biological science. An interest in animal work is essential.

Please apply to: G. G. Pursey, Personnel Officer, Glaxo Research Limited, Greenford, Middlesex, Tel. 01-422 3434 ext. 200, quoting reference AQ 103.

---

nonprint limited

Take the lead in labelling systems development.

Forming part of the well known Norcros Group, we are Europe's leading specialist manufacturer of labelling systems, and at our Headquarters at Boston we're currently looking for an enthusiastic and imaginative person to take up a secure and interesting position as a

Project Leader.

This post offers exceptional scope to the right person, who will join our well established team, currently engaged on a diverse range of projects encompassing areas of printing, adhesives and converting.
Ideally the successful applicant will hold a degree in Chemistry or Physics, although we should also like to hear from those with relevant H.N.D. combined with appropriate experience. In all cases, applicants must be able to demonstrate an aptitude for innovation and original thought.
Salary will fall in a range up to £4250 dependent upon qualifications and experience, and in addition to a number of attractive fringe benefits, generous assistance will be given with relocation expenses if applicable.

Please write together with full personal and career details to date, to Mr. D. E. O. Cubberley, Personnel Manager, Norprint Limited, Horncastle Road, Boston, Lincs.

NORCROS

British Museum (Natural History)

Assistant Scientific Officers

(men and women)

Vacancies in the Departments of Botany, Palaeontology and Zoology: the work consisting principally of preparing and labelling specimens, maintaining catalogues and registers of the collections, compiling indexes to the technical and scientific literature, and in some cases an involvement in research.
Also in the Museum Library, where the duties involve acquisitions, subject and bibliographical enquiries and general reference work.
Minimum qualifications, four passes in GCE at 'O' level or equivalent, including English language and a science or mathematical subject, (grades A, B and C only for examinations taken in Summer 1975).
Age, normally under 26 on 31 December 1975.
Starting salary £1276 (age 16)-£2051 (age 21) according to age, rising by annual increments to £2560 plus £410 Inner London Weighting.
Prospects of promotion to higher grades.
Application forms from Miss Pike, British Museum (Natural History), Cromwell Road, London SW7 5BD, telephone 589-6323, extension 441.
Closing date for receipt of completed applications 26 September 1975.

UNIVESITY COLLEGE DUBLIN
Botany Department

Applications are invited for two RESEARCH ASSISTANTSHIPS

funded by the National Science Council and commencing if possible on 1 October, 1975.

Assistantship 1: will be under the direction of Dr Patricia J. Boyle and will involve a study of *Spartina* in Ireland, including field work and cytological investigations. The appointment will be for one year in the first instance, and may be extended for a further year. Suitable candidates should have a degree in Botany, but applicants with a degree in Agriculture may be considered.

Assistantship 2: is concerned with the regulation of secondary metabolism in cultured plant cells using continuous culture techniques. It will be under the direction of Dr G. Wilson and will be for one year only. Graduates in Botany, Biochemistry or Microbiology are eligible.

The salary will be £1837 p.a. and further increases under National Wage Agreements will be allowed.

Applications, including curriculum vitae and the names and addresses of two referees, should be sent to: The Secretary, Botany Department, University College, Belfield, Dublin 4, to arrive not later than 26 September, 1975.

CHELSEA COLLEGE
University of London

BASIC MEDICAL SCIENCES GROUP

Applications are invited for the post of **LABORATORY TECHNICIAN GRADE 2B** to work in the teaching laboratories of the Department of Biochemistry. Training in a wide range of techniques is available within the Group and the successful applicant will receive every encouragement to undertake further education on e part-time basis.

Salary scale £2370–£2597 including London Allowence.

Application forms and further information can be obtained from **Mr K. F. Bromfield, Department of Biochemistry, Basic Medical Sciences Group, Chelsea College, Manresa Road, London SW3 6LX.**

FISH PHYSIOLOGIST

The Centre for Overseas Pest Research invites applications for the position of Scientific Officer/Higher Scientific Officer to work on aspects of the toxicity of insecticides and molluscicides to tropical food fish.

The position is offered initially for one year. Applicants should possess a first or second-class Honours degree.

Salary in the ranges £2559-£3937/£3664-£4864 respectively per annum according to age and experience.

Further information and application forms may be obtained by writing to the Administrative Secretary, Centre for Overseas Pest Research, College House, Wrights Lane, London W8 5SJ quoting reference FISHOL.

Closing date for reciept of applications is 30 September, 1975.

Tropical Products Institute, London

Information Scientist

■ Assist with scanning and indexing of literature on tropical agriculture ■ Emphasis on post-harvest activities and the technology and marketing of products ■ Answer a wide range of enquiries.

□ Degree, HNC or equivalent in an appropriate scientific subject □ Qualification in Librarianship or Information Service an advantage □ Knowledge of at least one foreign language desirable □ Age under 27 □ Appointment as Scientific Officer (£2560–£3960) □ Ref: SA 52/JD.

■ *Application forms (for return by 3 October 1975) from Miss C A Hall, Tropical Products Institute, 127 Clerkenwell Road, London EC1R 5DB.*

Ministry of Overseas Development
Land Resources Division, Surbiton

Training Officer (Land Resource Studies)

■ Participate in development studies and training in connection with integrated resource appraisal and planning in overseas countries ■ Primarily concerned with soil and water conservation layout and settlement planning ■ Periods of work overseas involved.

□ 1st/2nd hons degree in Agriculture or Agricultural Engineering, plus some years' tropical experience in soil and water conservation layout and settlement planning □ Age normally under 32 □ Appointment as Senior Scientific Officer (£4440–£6040) or Higher Scientific Officer (£3510–£4710) according to age and experience □ Ref: SA/11/JB.

■ *Application forms (for return by 13 October 1975) from Establishment Branch, Land Resources Division, 8th Floor, Tolworth Tower, Surbiton, Surrey KT6 7DY.*

Department of Agriculture and Fisheries for Scotland, Freshwater Fisheries Laboratory, Pitlochry

Biologist/ Biometrician

■ Develop methods of counting migrating salmon in Scottish rivers ■ Select sites for counter installations ■ Supervise processing of data on salmon catches using programmable calculator ■ Advise laboratory staff on data processing ■ Study long-term trends in stocks.

□ Honours degree in Zoology or Biology □ Knowledge of statistical techniques for biological work and application of computer techniques to data processing an advantage □ Age under 27 □ Appointment as Scientific Officer (£2150–£3525) □ Ref: SA/8/DLC.

■ *Application forms (for return by 3 October 1975) from Scottish Office, Personnel Division, PM(PTS) 1, Room 214, 22/25 Queen Street, Edinburgh EH2 1LY, telephone 031-556 9222, ext. 762.*

Ministry of Agriculture, Fisheries and Food, Torry Research Station, Aberdeen

Microbiologists

■ (Ref: SB/10/AJ): In Bacteriology Section ■ Participate in projects on fish spoilage, hygiene and sanitation ■ Work on methods for enumeration and identification of spoilage and food poisoning bacteria.

□ Degree, HNC or equivalent in Microbiology □ Age under 27 □ Appointment as Scientific Officer (£2150–£3525).

■ (Ref: SB/11/AJ): Work on National Collection of Industrial Bacteria ■ Maintain groups of bacteria and bacteriophages ■ Operate identification service ■ Research into long term methods of preservation.

□ 1st/2nd hons degree or equivalent in Microbiology □ Age under 27 □ Appointment as Scientific Officer (£2150–£3525).

■ *Application forms (for return by 3 October 1975) from Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours) or London 01-839 1992 (24 hour answering service).*

Science Group
CIVIL SERVICE

West of Scotland Health Boards
Department of Clinical Physics and Bio-Engineering

Principal Physicist Electronic Engineer in Computer Assisted Diagnostic Imaging

Applicants are invited for the post of Principal Physicist/Electronic Engineer for work on computer-assisted diagnostic imaging in a large department employing 200 scientists, engineers and technicians.

Applicants should possess high academic qualifications and substantial relevant experience in some of the following fields—computing, ultrasonics, thermography, nuclear medicine. The salary scale is £5844–£7824 per annum.

Application forms and further particulars may be obtained from the Director, Department of Clinical Physics and Bio-Engineering, 114 West Graham Street, Glasgow, G4 9LF, to whom completed applications should be sent before 26 September, 1975.

Microbiologist

in information publishing

A Graduate in microbiology or an allied subject is required to join the editorial team of **Microbiology Abstracts** in central London.

Please apply to:

IRL

Dr E S Krudy
Information Retrieval Ltd
1 Falconberg Court London W1V 5FG

RIVERS DIVISION
SCIENTIST'S DEPARTMENT

Assistant Divisional Scientist (Technical Support)

Salary £7353–£7941

Principal Scientific Officer (North)

Salary £5841-£6309

Senior Scientific Officer (2 Posts) (BIOLOGICAL)

Salary £4650–£5016

1 post at Carlisle 1 post at Warrington

The scientist's department has responsibilities for the control of pollution in internal, estuarial and littoral waters involving the sampling of river systems, trade effluent and sewage works, also carrying out the inspection of tips etc., and work under the Deposit of Poisonous Wastes Act 1972. Additionally investigations in relation to planning applications.

Further details and application forms from:
Divisional Administrative Officer, Rivers Division Headquarters, North West Water Authority, Bancroft House, Liverpool Road, Great Sankey, Nr. Warrington. Tel: Penketh 5531.
Closing Date: 26 September, 1975.

North West Water Authority

Tropical Products Institute, London

HEAD OF PROTEIN AND ANIMAL NEEDS SECTION

£5925 - £7600

. . . concerned with helping developing countries to exploit their resources for protein foods and animal feeding stuffs. The successful candidate will initiate and direct R & D work in this country and overseas, and give advice on the improved use of resources and the development of feed manufacturing industries. Some overseas travel is involved.

Candidates must have had considerable experience in applied animal nutrition and should normally have 1st or 2nd Class honours degree, preferably in nutrition or a related subject. Experience of the animal feeds industry would be an advantage.

Appointment, as Principal Scientific Officer with a starting salary between £5925 and £7600, may be permanent and pensionable (non-contributory) or, with present employer's agreement, on secondment terms.

For further details and an application form (to be returned by 19 September 1975), write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone Basingstoke (0256) 68551 (answering service operates outside office hours) or London 01-839 1992 (24 hour answering service). Please quote ref: S/9090.

Science Group CIVIL SERVICE

JOHN INNES INSTITUTE
Department of Applied Genetics

HIGHER SCIENTIFIC OFFICER/SENIOR SCIENTIFIC OFFICER

required for studies of the storage proteins in peas; this will involve further characterisation, investigation of their synthesis during seed development and analysis of their genetic control. This work complements that of a group within the Department studying various aspects of the genetics and molecular biology of seed development of peas. The Institute is extremely well equipped for all the necessary analytical techniques involved. Applicants should have a first or good second class honours degree. Preference will be given to candidates holding a PhD degree and relevant research experience in molecular biology or biochemistry, and with particular interest in the application of these studies. Further details may be obtained from Professor D. R. Davies, Head of the Department of Applied Genetics.

The appointment will be to the Higher Scientific Officer grade (£3254–£4454 pa) or Senior Scientific Officer grade (£4185–£5778 pa) according to qualifications and experience. At least 2 years relevant experience is required for appointment as HSO, with four years for SSO. There is a non-contributory pension scheme.

Applications with curriculum vitae, publication record and the names of three referees should reach the Secretary, John Innes Institute, Colney Lane, Norwich, NR4 7UH by 3rd October, 1975.

Biochemist

An Honours graduate in Biochemistry is required to join a multi-disciplinary project, which is studying methods for the control of Obesity.

Candidates should ideally have had one to two years' post graduate research experience and should have an interest and knowledge of one or more of the following topics :- control of energy metabolism, hormonal control mechanisms, lipogenesis and lipolysis.

The project is located at the Nutritional Research Centre Walton Oaks, which is in pleasant countryside near Dorking. The Company offers a good starting salary along with other benefits such as a non-contributory pension scheme ; sick pay and generous holidays.

If you are interested in applying for this post please write, enclosing a curriculum vitae to :-

The Site Personnel Officer, Beecham Pharmaceuticals, Research Division, Nutritional Research Centre, Walton Oaks, Dorking Road, Tadworth, Surrey KT20 7NT

1972

UNIVERSITY COLLEGE LONDON
Department of Psychology

RESEARCH ASSISTANT

required for a project involving the comparative study of human and gorilla infants. Duties will include transcription and analysis of behaviour recorded on video-tape, as well as direct observation of zoo animals.

The applicant should be a graduate in psychology, zoology or anthropology. The project is financed by the Medical Research Council, and the appointment is for one year, commencing on 1 October, 1975. The salary will be £3177 inclusive (subject to review).

Applications, together with the names of two referees, should be sent as soon as possible to Mr E. W. Bridger, Assistant Secretary (Personnel), University College London, Gower Street, London WC1E 6BT.

UNIVERSITY OF BRISTOL

RESEARCH ASSISTANT

required for Research Council work involving studies on the effects of environmental changes on the physiology of fish respiration. A degree of Zoology or Physiology with particular interest in the use of gas analysis and electrical recording techniques is desirable.

Starting salary up to £2574 per annum (plus an as yet undecided cost-of-living element).

Applications naming two referees should be sent to Professor G. M. Hughes, Research Unit for Comparative Animal Respiration, University of Bristol, Woodland Road, Bristol BS8 1UG before 27 September, 1975.

UNIVERSITY OF GLASGOW
Institute of Physiology and Department of Electronics and Electrical Engineering
RESEARCH ASSISTANT

Applications are invited for a post as Research Assistant for three years from 1st October 1975 to work on an interdisciplinary project (financed by the Wellcome Trust) involving the application of electronics and computer based techniques to the study of control of movement.

Candidates should have a degree in Electronics, Electrical Engineering or Applied Physics and several years practical experience of digital and analogue electronic circuit design. Some knowledge of the biological sciences and of minicomputers would be an advantage.

Salary depending on qualifications and experience within the range £2862-£4404 per annum of the salary scale for research and analogous staff, range 1A (presently under review).

Further particulars may be had from Professor I. Boyd, Institute of Physiology, University of Glasgow, Glasgow, G12 8QQ to whom applications should be lodged on or before 15th September, 1975.

In reply please quote Ref. No. 3727.N

COUNTRY KITCHEN FOODS LTD.
require a
GRADUATE
in their Research and Development Department at Buxton in Derbyshire, to work on technical problems related to the cultivated mushroom. The job will involve varied technical and scientific work on an exacting crop grown under controlled environment conditions.

The successful applicant is likely to have graduated in Agriculture, Microbiology or a related subject within the past two years and have worked for a time in Agriculture or industry. Previous experience of mushrooms is not required but candidates should have a sound, broadly based scientific knowledge combined with good practical ability.

Applications to: Mr R. C. Ross, Country Kitchen Foods Ltd., Harpur Hill, Buxton, Derbyshire, SK17 6YB.

HOUGHTON POULTRY RESEARCH STATION
SCIENTIFIC OFFICER
with a pass degree HNC or equivalent qualifications required for Physiology and Biochemistry Department to take charge of electrophoretic techniques and assist with the running of a new radioisotope unit.

The appointment will be in the Scientific Officer grade within the scale of £2140 to £3527, according to qualifications and experience.

Non-contributory pension scheme.

Further particulars and application forms from the Secretary, Houghton Poultry Research Station, Houghton, Huntingdon, Cambs. PE17 2DA.

Closing date for applications 26 September, 1975.

FAUNA PRESERVATION SOCIETY
Responsible secretarial assistant required. £1700 minimum. Interesting work, involving some shorthand. Write giving full details to FPS, c/o Zoo, Regent's Park, London, NW1 4RY.

THE BRITISH LIBRARY
RESEARCH ASSISTANTS

Three posts in London:

Rare Books Collection
. . . to catalogue English books of the period 1501-1800 and undertake information work in this field; and to take part in the information service in the reading rooms. Candidates must have a good degree or equivalent in an Arts subject and a sound working knowledge of Latin.

Science Reference Library (2 posts)
One post involves the selection of material such as monographs, periodicals and reports for the collections; the development of new collections; and the provision of information services to an industrial audience. Candidates must have a degree or equivalent in a scientific or technological subject and should have had relevant experience.

The second will entail cataloguing scientific publications in English and other Western European languages for MARC—compatible computer based cataloguing system. Candidates must have a degree or equivalent and some experience of cataloguing, using the Anglo-American Cataloguing Rules.

SALARIES: as RA Grade I £3660-£4860 or RA Grade II £2560-£3935. Level of appointment and starting salary according to age, qualifications and experience. Non-contributory pension scheme.

For full details and an application form (to be returned by 2 October 1975) write to Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB, or telephone BASINGSTOKE (0256) 68551 (answering service operates outside office hours) or LONDON 01-839 1992 (24 hour answering service). Please quote G (38) 382.

BL

Technical Administration

Travenol manufacture and market disposable hospital equipment.

We have a vacancy in our Quality Control area for a person with a science qualification, HND/C/Degree, preferably in chemistry or microbiology, to carry out the technical administration connected with the quality assurance of product batches.

Applications should be made to:

J. D. Woods,
Travenol Laboratories Ltd.
Caxton Way,
Thetford, Norfolk IP24 3SE

LOUGHBOROUGH CONSULTANTS LIMITED

NOISE CONTROL UNIT

Applications are invited from qualified engineers or scientists with experience in noise control for a post in the Noise Control Unit.

The successful applicant, who will be technically responsible to a senior member of the academic staff of Loughborough University of Technology, will be expected to maintain and develop the Company's business in industrial and environmental noise control. The job will require the engineer to take part in visits to potential clients, preparation of proposals, noise measurement and site design, development and installation of noise control measures.

Salary from £3000.

Applications giving personal details and career information should be sent to:
R. E. H. Coles
Business Manager
Loughborough Consultants Limited
University of Technology
Loughborough
Leicestershire
LE11 3TU

QUEEN MARY COLLEGE
University of London
COMPUTER ASSISTED LEARNING

Two Graduate Research Assistants required for the Engineering Science Project developing and implementing computer - based teaching materials. This is part of the NATIONAL DEVELOPMENT PROGRAMME IN COMPUTER ASSISTED LEARNING. Applicants should have an interest in innovation in teaching methods; a degree in engineering, science or mathematics is desirable as is experience of computing. One post is suitable for a new graduate. Appointment will be for up to two years from October 1975. Salary scales: Post A —£2437-£3385 p.a. or £2756-£4618 p.a. according to experience/qualifications; Post B—£2437-£3385 p.a. These figures include London Allowance and Threshold and from 1 October are expected to be not less than £2768-£3893 p.a. and £3177-£5421 p.a. including London Allowance. Further details obtainable from Dr P. R. Smith, (NS) Nuclear Engineering Department, Queen Mary College, Mile End Road, London E1 4NS and applications should reach The Registrar not later than 30 September 1975.

UNIVERSITY OF SHEFFIELD

RESEARCH TECHNICIAN
(Grade 3 or 5)

required in the Age Determination Laboratory, the Department of Physics, to work on dating lunar samples and meteorites. Duties involve operation and maintenance of mass spectrometers. ONC/HNC or equivalent with previous experience in High Vacuum Technology and/or Electronics desirable.

Appointment initially to 31st March 1980.

Salary range £2013–£2895 p.a.

University employees enjoy security, good working conditions in pleasant surroundings, excellent holiday entitlement and sick pay arrangements and a generous Superannuation scheme. Please write to the Deputy Director of Services, (Ref. S411/NS), The University, Sheffield S10 2TN.

BRISTOL POLYTECHNIC
Department of Science

Applications are invited for the following post, duties to commence as soon as possible:

TECHNICIAN (GRADE T1) IN BIOLOGY

The successful applicant will initially assist a Senior Technician with the running of the Microbiology suite. The work will mainly involve general preparation of media, preparation and laying out of materials required for practicals and assistance in the sub-culture and preservation of a large collection of organisms.

Preference will be given to applicants with Microbiology experience.

Applicants should preferably possess an ONC or Intermediate City and Guilds or similar qualification.

Salary Scale: T1 £2040-£2196 (bar)-£2529.

Additions of £42 or £72 for appropriate National Certificate or City and Guilds qualification.

Further details and application forms (to be returned by 22 September 1975) from Personnel Office, Bristol Polytechnic, Ashley Down, Bristol BS7 9BU.

Please quote Post Reference Number T42/146 in all communications.

LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

LECTURER IN GUIDED VEHICLE SYSTEMS

Applications are invited for the above post in the Department of Transport Technology from candidates with experience in guided vehicle surface transport systems. A specialist knowledge of traction, suspension, or performance, together with a general knowledge of the economics and operation of tracked vehicle systems would be an advantage. The successful candidate will be required to teach on departmental programmes and to direct and undertake research.

Salary within notional scale £2778–£6050 plus threshold payment. Postcard requests for application forms and further details should be sent to the Assistant Registrar, (Establishment) Ref: 75/30TT (X).

Loughborough *Leicestershire*

UNIVERSITY OF LEICESTER
Department of Physics

RESEARCH ASSOCIATE IN IONOSPHERIC PHYSICS

Applications are invited for the post of Research Associate in the Ionospheric Physics Group. The research programme is concerned with the investigation of disturbances in the lower ionosphere of solar and magnetospheric origin. This work forms part of the international co-operation for the forthcoming International Magnetosphere Study.

Candidates should preferably hold a higher degree in Physics, Electrical Engineering or Mathematics. Starting salary will be £2778 per annum. (This salary may be augmented by a cost of living increase subject to the provisions of the recently published pay policy guidelines).

Applications to Dr T. B. Jones, Department of Physics, The University, Leicester, LE1 7RH.

Wellcome

THE WELLCOME RESEARCH LABORATORIES—Beckenham

Clinical Chemistry

Quality Control Reagents

A graduate chemist or biochemist is required to join a small team working on the development of a range of related products. Some experience of clinical chemistry would be an advantage, but an interest in methodology coupled with a flexible attitude towards widely differing problems would be equally valuable. Applicants should be aged 25 years or over with a good first degree or relevant post-graduate qualifications.

The laboratories are situated in pleasant parkland surroundings within easy reach of Bromley and Beckenham and about 12 miles from Central London. Conditions of employment are attractive and include 4 weeks' holiday, subsidised canteen, excellent sports and social facilities and assistance with re-location expenses where appropriate.

Please write giving brief details of background and experience to: The Personnel Manager, The Wellcome Research Laboratories, Langley Court, Beckenham, Kent BR3 3BS.

Avon Area Health Authority (Teaching)

Frenchay District, Bristol

Applications invited for a Basic Grade

Biochemist

to work with the Principal Biochemist in the District Laboratory based at Frenchay Hospital (550 beds); the hospital being a regional centre for Plastic, Thoracic and Neuro-surgery.

Whitley Council Conditions of Service.

Further information obtainable from Dr G. R. Philpot, Pathology Laboratory, Frenchay Hospital, telephone Bristol 565656 extension 281.

Applications giving age, qualifications, experience and the names of two recent referees to the Personnel Officer, Frenchay Hospital, Bristol BS16 1LE.

JUNIOR TECHNICIAN

required in the Pharmacology Department. Day release given. Salary according to age (£1452 at 17 years, £1602 at 18 years) plus £312 London Allowance. 4 weeks annual holiday. Apply in writing, stating age and details of education, to the **Secretary, Guy's Hospital Medical School, London Bridge, SE1 9RT quoting Ref. P.H.**

THE EDINBURGH SCHOOL OF AGRICULTURE

RESEARCH ASSISTANT

Applications are invited from graduates in mathematics, computer science, agricultural science or with other suitable qualification, for a three-year appointment to work on physiologically-based mathematical models for predicting animal growth.

Salary, £1809–£2118 with superannuation and cost-of-living allowance.

Further particulars from the **Secretary, the Edinburgh School of Agriculture, West Mains Road, Edinburgh EH9 3JG.**

MINISTRY OF OVERSEAS DEVELOPMENT
Tropical Products Institute

ASSISTANT SCIENTIFIC OFFICER

The TPI carries out research to aid developing countries in the extension and improvement of their renewable natural resources. Applications are invited for an Assistant Scientific Officer with an interest in plant biology to assist in experimental work on the storage physiology of tropical crops. Minimum qualifications are 4 GCE 'O' level passes of CSE Grade 1 passes, including English Language and one science subject. Preference will be given to candidates with passes in botany, biology, or chemistry. Salary at age 16 £1686; at 18 £1965 rising to a maximum of £2970. There are opportunities for day release and promotion to higher grades. 41 hours per week, including lunch breaks; 20 working days annual leave per year plus 9½ Public and Privilege holidays. The post is permanent and pensionable.

Applications from Miss C. A. Hall, Tropical Products Institute, 127 Clerkenwell Road, London, EC1R 5DB. 01-405-7943.

CENTRAL PUBLIC HEALTH LABORATORY

A GRADUATE

with an appropriate degree in a scientific subject is needed by the cross-infection reference laboratory to assist in the assessment of results from laboratory and field investigations. Experience in data interpretation and handling would be an advantage, but no technical knowledge of statistics is necessary. National Health Service terms and conditions of service and superannuation.

Applications to the Personnel Officer, Central Public Health Laboratory, Colindale Avenue, London NW9 5HT, stating age, qualifications and experience, together with names and addresses of 2 referees.

UNIVERSITY OF MANCHESTER
CHAIR OF THEORETICAL PHYSICS

Applications are invited for a Chair of Theoretical Physics in the Faculty of Science. Consideration will be given to candidates whose interests are in fields other than nuclear or high energy physics but preference will be given to those whose interests are related to those of one more of the non-nuclear experimental groups in the Department. Further details of these groups, together with particulars of the appointment, may be obtained from the Registrar, Salary within the professorial range. Superannuable. Applications (2 copies, I suitable for photocopying) giving full details of qualifications, experience, research etc. and the names and addresses of three persons to whom reference may be made should be sent to the Registrar, The University, Manchester M13 9PL by October 31st, 1975. Please quote reference 169/75/NS.

THE AGRICULTURAL RESEACH COUNCIL

has a vacany in the Unit of Invertebrate Chemistry and Physiology at the University of Sussex for a chemist to participate in the initiation of a programme of research on the chemical identification of insect pheromones.

Projects for immediate attention include oviposition attractants, aggregation pheromones and sex attractants for the mushroom fly and possible attractants for the whitefly parasite. This work would be carried out in collaboration with the entomologists at the Glasshouse Crops Research Institute, who would be responsible for insect rearing and for the bioassay of biologically active material.

The appointment will be in the Higher Scientific Officer or Senior Scientific Officer grade, according to qualifications and experience.

Applicants should possess a good honours degree and at least 2 years appropriate research experience for the HSO grade, and at least 4 years appropriate research experience for the SSO grade.

Experience in physical methods of analysis and of work with biological material would be desirable.

Salary HSO £3254-£4454 p.a.
SSO £4185-£5778 p.a.

Applications should be sent to: The Secretary, A.R.C. Unit of Invertebrate Chemistry and Physiology, University of Sussex, Falmer, Brighton. BN1 9QJ.

WESTFIELD COLLEGE
(University of London)
TEMPORARY LECTURESHIP IN BIOCHEMISTRY

Applications are invited for this post tenable from 1 January, 1976. The successful applicant will be attached to the Department of Botany and Biochemistry (Professor F. J. Peterson) and will be required to assist in the development of undergraduate courses for Biochemistry Joint Programmes in collaboration with other staff in the Faculty of Science. The appointee will also be expected to undertake research and participate in the training of postgraduate students. The post is initially for three years and will be on one of the bottom three spots of the lecturer scale (£2778, £2982 or £3186 plus £309 London Weighting Allowance; under review). Further details of the post and of current research activities and facilities may be obtained from Dr J. Buckingham. (NS) Personnel Officer, Westfield College, Kidderpore Avenue, Hampstead, NW3 7ST to whom applications (three copies), together with the names of two referees, should be sent by 23 September, 1975.

"INTERNATIONAL ABSTRACTS OF BIOLOGICAL SCIENCES"
AN EDITORIAL AND INDEXING ASSISTANT

is required to work on the above journal.

The post would suit a recent graduate with a degree in Microbiology, or a general degree with emphasis on Microbiology.

Offices in pleasant surroundings on the outskirts of Oxford.

Further details and an application form may be obtained from:—

Dr A. N. Rowan, IABS, Pergamon Press Limited, Headington Hill Hall, Oxford, OX3 0BW. Telephone Oxford 64881.

Senior Pathologist

Huntingdon Research Centre is a contract research organisation working in the safety evaluation of pharmaceuticals, biologicals and agrochemicals. Although the work is sponsored by commercial contracts, there is a high scientific content in the overall research effort.

We need a veterinary or medical pathologist to join a multi-disciplinary team in a general toxicology area. Senior posts in this team are held by veterinarians and medical practitioners. You should be qualified in either the veterinary or medical professions and have had experience in comparative pathology, preferably in a research establishment, in industry or in an academic institution. Attendance at scientific meetings and the publication of scientific papers are encouraged.

Salary, career prospects and benefits are competitive with industry and are consistent with our position as part of a major international group. The location itself has many advantages: Huntingdon is situated in pleasant countryside and housing prices are among the lowest in Britain. At the same time, Cambridge, London and the Midlands are within easy reach by road and rail. You will be given help with relocation expenses.

For further details, phone or write to: David Prentice, Head of Pathology Department, Huntingdon Research Centre, Huntingdon PE18 6ES. Phone Huntingdon 890431.

HRC

Scientific Publishing

Salary £2600-£2700 pa

Longman Group Limited are currently expanding their Dictionary and Reference Book Section at Harlow, Essex, and require an additional person to complete the team of Lexicographers.

Applicants, who must hold a degree in Biology or Chemistry, will be engaged in the preparation of the scientific and technical entries. Teaching or research experience would be an advantage.

For further details and application form, please write to: The Personnel Manager, Longman Group Ltd., Longman House, Burnt Mill, Harlow, Essex CM20 2JE or telephone Harlow 26721 Ext 31.

Longman

MEDICAL RESEARCH COUNCIL UNIT OF CLINICAL PHARMACOLOGY
University Department of Clinical Pharmacology
Radcliffe Infirmary
Oxford OX2 6HE

TWO TECHNICIANS

are required for interesting posts, one to assist in the study of biochemical and pharmacological responses of blood platelets in patients undergoing drug treatment, the other to assist in studies on the responses of isolated smooth muscle preparations to human biological fluids. For the first general experience in biochemical pharmacology is required and for the second experience in pharmacological techniques would be an advantage. Applicants should have HNC, degree or equivalent qualifications. Salary will be within the range of £2511-£3738.

Applications with the names of two referees should be sent to Professor D. G. Grahame-Smith at the above address by September 30.

MEDICAL RESEARCH COUNCIL
Dunn Nutrition Unit
Milton Road, Cambridge
CB4 1XJ

Applications are invited from

NUTRITIONISTS/ DIETICIANS

for a post to be filled immediately for work on obesity and on dietary fibre. Studies will initially be conducted on a community basis but metabolic work will begin once facilities are available. Would applicants please apply to Dr W. P. T. James at the above address by September 30. Salary according to age, qualifications and experience. Information may be obtained by telephoning Cambridge 63356.

MRC DUNN NUTRITION UNIT
Milton Road, Cambridge
CB4 1XJ

A vacancy exists for a medically qualified epidemiologist to work in connection with a variety of nutritional studies in Britain and overseas. The main responsibility, however, would be a community study of obesity and its relationships to health. Details will be supplied to suitable candidates. The post would be suitable for a young medical graduate with experience or training in community medicine or epidemiology.

Applications should be sent to Dr W. P. T. James by 31 March 1975.

MEDICAL RESEARCH COUNCIL
Dunn Nutrition Unit
Milton Road, Cambridge
CB4 1XJ

A vacancy exists for a

TECHNICIAN'S

post to work with a team studying problems of energy balance and obesity in man. Candidates with biochemical and/or physiological experience are needed. Salary according to age and experience. Applications giving details of qualifications and previous work, with the names of two referees, should be sent to Dr W. P. T. James at the above address by 30 September.

HONOURS GRADUATES WHERE WOULD YOU LIKE TO START YOUR CAREER



There are 750 Tax Offices all over the U.K. If you join the Inland Revenue as an Inspector of Taxes you can normally start work in the part of the country you favour. Your career path is carefully planned—later moves will ensure that you get experience of a wide variety of tax problems. The thorough training you receive will give you the ability to negotiate with kinds of businessmen and their professional advisers on equal terms. During your career you could take charge of the tax affairs of an entire district with wide powers of discretion. You may also spend periods on more specialised aspects of taxation and acquire an enviable professional expertise—in itself a valuable career asset.

Qualifications: Under 32. A degree with honours—at least second-class honours ability is normally required. Final year students may apply.

If you start at 21, your salary should be over £4200 at 23, over £5600 at 27. By your mid-30's you should be earning over £9000 and by 40 you could be in a post which takes you to £11000. Salaries up to £400 higher in London.

To find out more, and for an invitation to visit a Tax Inspector, write to: Civil Service Commission, Alencon Link, Basingstoke, Hants RG21 1JB Please quote: A/320/K/7

A CAREER THAT APPEALS TO REASON

UNIVERSITY OF DURHAM
Department of Psychology

Applications are invited for the post of

RESEARCH ASSISTANT

on an MRC project concerned with the control of milk intake in new born rats and rabbits, under the direction of Dr R. F. Drewett. Candidates should have a degree in psychology or a biological subject.

Appointment will be from 1 October 1975 or as soon as possible thereafter, for one year in the first instance, and may be extended to three years in all.

Starting salary will not exceed £2574 per annum on National Research Range (1B).

Applications (3 copies) naming three referees should be sent by 19 September 1975 to the Registrar and Secretary, Science Laboratories South Road, Durham DH1 3LE, from whom further particulars may be obtained.

LA TROBE UNIVERSITY
Melbourne, Australia

LECTURER IN ZOOLOGY

Applications are invited for the post of lecturer in the Department of Zoology. The applicant should have research interests within the field of invertebrate of vertebrate physiology other than endocrinology.

Salary: $A11 655-7 x $570-$15 645.

Further information and application forms are available from the Association of Commonwealth Universities (Appts), 36 Gordon Square, London WC1H 0PF, or from the Registrar, La Trobe University Bundoora, Victoria, Australia 3083.

Applications close on 30 October, 1975.

TECHNICIAN

for interesting and varied work in Veterinary Pathology Laboratory. Experience in most disciplines essential. Attractive salary and benefits available. Phone Retford (0777) 3011 for details.

MEDICAL RESEARCH COUNCIL
NATIONAL INSTITUTE FOR MEDICAL RESEARCH

Science Graduate

in Chemistry or Biochemistry

required to work in the division of Biophysics on research concerned with the isolation and characterisation of plasma proteins. The work would involve the use of a wide variety of techniques including electophoresis, chromatography and several immunological methods.

Initial salary depends on qualifications and experience between £2823 p.a. and £4050 p.a. Training will be provided but experience of the relevant area of research would be an advantage.

Please apply quoting Ref: T-RO/BP. to Mrs M. Y. Jim, Assistant Personnel Officer, N.I.M.R., The Ridgeway, Mill Hill, NW7 1AA. Tel: 01-959-3666.

TECHNICIAN

(full/part time)

required for diagnostic and research work on genital-urinary cancer. Previous experience desirable, but not essential. Salary according to age and qualifications. Applications to the Pathologist, St. Paul's Hospital, Endell Street, WC2H 9AE.

PLYMOUTH POLYTECHNIC

School of Environmental Sciences

LECTURER II IN SYSTEMS ECOLOGY

Applicants should have an interest in the application of systems analysis and modelling to ecological systems. Experience in modelling aquatic systems such as plankton and/or fish stocks would be advantageous.

Exceptional candidates might be considered at S.L. level.

Further details and application forms from the Personnel Officer (NS.11.9.).

PLYMOUTH POLYTECHNIC DRAKE CIRCUS PLYMOUTH PL4 8AA

LONDON BOROUGH OF ENFIELD EDUCATION COMMITTEE

LABORATORY TECHNICIAN

required at Winchmore School, Laburnum Grove, London N21 3HS. This is a new post. Applicant should be preferably qualified or experienced.

Salary in accordance with Technical Grade I (£1215 to £2529 per annum plus London Weighting) commencing at £2193 per annum rising to £2529 per annum plus London Weighting. There is a bar on the Technical I scale at £2193 per annum (exclusive of London Weighting).

Application forms and further particulars are available from: The Chief Education Officer, P.O. Box 56, Civic Centre, Enfield EN1 3ES, and should be returned to him by 26 September, 1975.

LABORATORY TECHNICIAN

required for Physics Department. Salary on ILEA Scale 2B (£2271-£2598) or 3 (£2424-£2754). Laboratory Technician Scales, including London Allowance. Apply giving details of age, education, experience and the names and addresses of two referees to The Master, Dulwich College, London, SE21 7LD.

Wellcome

THE WELLCOME RESEARCH LABORATORIES—Beckenham

Biologist

for Department of Protozoology

An opportunity has arisen in the Protozoology Department for a biologist to join a research group studying the chemotherapy of trichomoniasis. The work includes development of animal models for the disease and extensive in vitro studies. Applicants should be aged 25-30 years with postgraduate experience in parasitology and a knowledge of culture techniques. A biochemical background would also be an advantage.

The laboratories are situated in pleasant parkland surroundings within easy reach of Bromley and Beckenham and about 12 miles from Central London. Conditions of employment are excellent and include 4 weeks' holiday, subsidised canteen, excellent sports and social facilities and assistance with re-location expenses, where appropriate.

Please write, giving brief details of background and experience, to: The Personnel Manager, The Wellcome Research Laboratories, Langley Court, Beckenham, Kent BR3 3BS.

BP

BP PROTEINS LIMITED

Nutritionists

ANIMAL FEEDS

Following the extension of their activities into the compound animal feed industry in the United Kingdom and abroad, BP Proteins Limited require 2 experienced nutritionists in this field.

These appointments are in the animal feed division which is responsible, within BP, for organising and co-ordinating experimental programmes with feed manufacturers, universities and research establishments in addition to providing a central source of nutritional expertise.

The main areas to be covered will be in poultry and calf nutrition, together with certain other specialist applications including domestic pets.

These appointments offer interesting and challenging prospects in an expanding company which has pioneered the use of single-cell proteins in animal feeding.

Candidates must have had at least 5 years' experience in nutrition research in either an academic or industrial environment. They must be people of initiative who are capable of creative thinking Knowledge of one of the major European languages will be an advantage but is not a pre-requisite. The company offers a competitive salary, and other fringe benefits include non-contributory pension scheme, subsidised restaurant and first class social/sports facilities.

Please write, giving details of age, qualifications and experience, quoting reference AQ.86, to: The Manager, Central Recruitment, The British Petroleum Company Limited, Britannic House, Moor Lane, London EC2Y 9BU.

BREWING INDUSTRY RESEARCH FOUNDATION

Nutfield, Surrey

EXPERIMENTAL OFFICER

An Experimental Officer is required in the Biochemistry Section to take part in studies of the alterations in endosperm structure which occur when barley is malted. Candidates should hold a degree in botany and have a particular interest in the various techniques of microscopy.

The appointment will be made within the salary range £2637-£3443-£4066.

Superannuation will be under the Institute of Brewing Superannuation Scheme with life insurances as an extra benefit.

Applications, including a curriculum vitae, should be sent to the Administrative Manager, Brewing Industry Research Foundation, Nutfield, Redhill, Surrey, RH1 4HY, to arrive not later than 25th September, 1975.

CHARING CROSS HOSPITAL (FULHAM)

BIOCHEMIST (BASIC GRADE)

Graduate in chemistry or biochemistry required in Department of Forensic Medicine for toxicological analysis of body fluids. Experience with modern analytical techniques an advantage.

Salary scale £2589-£3702 inclusive. Entry point dependent on qualifications. Whitley Council conditions of employment apply.

Apply to Mr C. J. Hill, Personnel Department, Fulham Palace Road, Hammersmith W6 8RF. Phone 01-748 2050 (Ext. 2992).

SENIOR ENGINEER

Newcastle upon Tyne

up to £5505

British Gas is seeking a Senior Engineer to make economic and engineering appraisals of materials and practices associated with gas distribution networks at the Engineering Research Station, Newcastle upon Tyne.

Candidates should have a degree or equivalent in a scientific or engineering subject with at least five years' experience of applying scientific thinking to engineering problems. A knowledge of engineering method, basic economics and statistics is essential. Excellent conditions of service are offered including pension and sick pay schemes.

Salary is in the range £4278-£5505.

Applications giving full details should be sent to the Senior Personnel Officer (R&D), British Gas, 59 Bryanston Street, London W1A 2AZ quoting reference RD/ERS/439/NS.

BRITISH GAS

STATE REGISTERED OR JUNIOR MEDICAL LABORATORY TECHNICIAN

required to work in clinical chemistry field on effects of prostaglandin on serum hormone levels. The post is based in the Obstetric Unit of this large teaching hospital.

Salary and conditions of service according to Whitley Council agreements. For further details ring Mr Whyley, 387-9300, Ex. 191. Application forms obtainable from Personnel Department, University College Hospital, Gower St., London, WC1E 6AU.

UNIVERSITY OF SOUTHAMPTON

PROFESSOR OF ELECTRONICS

Applications are invited for appointment to a Chair of Electronics, which became vacant on the appointment of Professor G. D. Sims as Vice-Chancellor of the University of Sheffield.

Further particulars may be obtained from the Academic Registrar, The University of Southampton, SO9 5NH, and applications (11 copies from applicants in the United Kingdom and one from others) must be submitted before 31 October, 1975.

SCIENTISTS! TECHNICIANS!

We have current requirements for:

ALL GRADES OF TECHNICIANS & SCIENTISTS

1. To work in (Research & Routine): HAEMATOLOGY, HISTOLOGY, BIOCHEMISTRY, MICROBIOLOGY, and particularly VIROLOGY
2. To act as: TECHNICAL ADVISORS FOR THE PROMOTION OF DIAGNOSTICS & SCIENTIFIC INSTRUMENTS
   Salaries: £2000–£5500

For further details of these and other opportunities in and out of the laboratory, contact:

Scientific Staff Consultants

50 LINCOLNS INN FIELDS, LONDON, WC1 01-831 6471

Our service is free to applicants

Teesside Polytechnic

TWO NEW COURSES IN BIOCHEMICAL ENGINEERING

1. Biochemical Engineering Degree Option

Four year sandwich CNAA BSc Honours Degree.
Entrants 2 'A' levels, Chemistry, Mathematics and Physics or equivalent.

2. HND Biochemical Engineering Option

Two years full time course HND
Entrants 1 'A' level Chemistry, Physics, Mathematics, Engineering Science or a Biological Science.

Details from: Mr G. Street
Department of Chemical Engineering,
Teesside Polytechnic, Middlesbrough,
Cleveland TS1 3BA Telephone 0642 44176

LECTURES, MEETINGS AND COURSES

MSc Radiation Science

This part-time course leads to a CNAA award. It covers the theory and applications of a wide range of techniques, based on the use of ionising radiations, in medical, industrial and other areas. The subject is an interdisciplinary one and the treatment is designed to accommodate applicants with degrees or the professional equivalent in most science subjects.
Attendance is for two sessions per week for a period of two to three years depending on the subject content and the academic level of entry qualifications. Postgraduate experience may be taken into account in this respect.
Further details and an application form are available from:

The Science Faculty Registrar, Ref. BJ188, North East London Polytechnic, Romford Road, London, E15 4LZ. Tel: 01-555 0811.

NELP North East London Polytechnic

KINGSTON POLYTECHNIC

Msc in TECHNOLOGY and MARKETING of INDUSTRIAL CHEMICALS (part-time)

A two-year part-time course designed to give graduate chemists and related scientists an in-depth appreciation of the technological, economic, marketing and social factors involved in the business activity of industrial chemicals, including plastics.

A major part of the course is the project/dissertation which can be company orientated.

For further details contact School of Chemical and Physical Sciences, Kingston Polytechnic, Penrhyn Road, Kingston upon Thames. Telephone: 01-549 1366.

pcl

The Polytechnic of Central London

School of Engineering and Science

MSc courses in Instrumentation

Three two-year part-time day courses (9.30 a.m. to 7.30 p.m. one day a week) begin on the first Wednesday in October 1975. They are (a) Physical Instrumentation (b) Instrumentation and Systems Engineering and (c) Biomedical Instrumentation.

Enquiries and applications to: The Registry of Engineering and Science The Polytechnic of Central London, 115 New Cavendish Street, London W1M 8JS. Tel: 01-486 5811 ext. 6241

SCIENCE FOR THE LAYMAN AT MORLEY COLLEGE

Evening courses in Microscopy, Botany (daytime also), Natural History, Astronomy (using college observatory and planetarium), Birdwatching, Ornithology, Geology, Conservation, Food, Modern Medicine, Gardening and Electronics. Saturday morning courses in Wildlife Film-making (monthly) and Film Editing. For the family (monthly)—Astronomy (Sat. 10-12) and Natural History (Sat. 2.30-4.30).

For further information apply to Morley College, 61 Westminster Bridge Road, London SE1 7HT, tel: 01-928 8501.

FELLOWSHIPS, GRANTS AND SCHOLARSHIPS

THE UNIVERSITY OF LEEDS
DEPARTMENT OF MECHANICAL ENGINEERING

RESEARCH FELLOWSHIP IN BIOMECHANICS

Applications are invited from suitably qualified engineers or scientists for the above post within the Biomechanics section of the department. The project is sponsored by ICI Corporate Laboratory and Pharmaceuticals Division under the ICI short research scheme and the programme is concerned with the design and evaluation of artificial heart valves.
Applicants should possess a good first degree and preferably a higher degree together with industrial or research experience. The appointment would be for three years and the salary, according to the qualifications and experience, would be within the range £2778-£4206 (plus FSSU benefits).
Previous experience in biomechanics or fluid mechanics would be an advantage but is not essential.
Applications, giving the names and addresses of two referees, should be addressed to Dr P. D. Swales, Department of Mechanical Engineering, The University, Leeds LS2 9JT.

THE ENGLISH-SPEAKING UNION OF THE COMMONWEALTH

Applications are invited for

LINDEMANN TRUST FELLOWSHIPS

from highly qualified graduates wishing to continue research in the Physical Sciences at institutions in the United States.

The awards, which will carry stipends of the order of $12 500 will be tenable for the academic year 1976/77, but an extension of tenure may be granted at the discretion of the Committee.

Further particulars and application forms can be obtained from:

The Secretary, Lindemann Committee, English-Speaking Union, 37 Charles Street, London W1X 8AB.

Completed forms should be returned not later than November 10th, 1975.

UNIVERSITY OF READING
POSTDOCTORAL FELLOW IN CHEMISTRY

Applications are invited for an SRC Postdoctoral Research Fellowship to carry out research in Inorganic/Organometallic Chemistry. The appointment is for one year and is renewable for a second year. Salary will be at the usual SRC rates. Applications, including brief curriculum vitae and names of two referees should be sent to Professor G. W. A. Fowles, Chemistry Department, The University, Whiteknights, Reading. (Ref. MS34).

New Scientist is printed in Great Britain by Index Printers, Oldhill, London Road, Dunstable, Beds., and Thomas Jenkins (Printers) Ltd, 108 Weston Street, London SE1 and published by IPC Magazines Ltd, 128 Long Acre, London WC2E 9QH. Publishers' annual subscription rates: Inland £12·50; USA and Canada (airfreight) $37·50; other overseas £13·75. Sole Agents for Australia and New Zealand, Gordon & Gotch (A'sia) Ltd. For South Africa: Central News Agency Ltd. Conditions of sale: this periodical shall not, without the written consent of the publishers first given, be lent, resold, hired out or otherwise disposed of by way of trade at more than the recommended selling price shown on the cover (selling price in Eire subject to VAT) and it shall not be lent, resold or hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of trade or annexed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

UNIVERSITY OF ASTON IN BIRMINGHAM

DEPARTMENT OF CHEMISTRY

RESEARCH FELLOWSHIPS IN BIOCHEMISTRY

Applications are invited from chemists or biochemists with good honours degrees and appropriate postgraduate experience, for two posts of Research Fellow.

The first post is for the investigation of the differences in folate metabolism between normal and malignant tissues. The second post is to conduct research into folate metabolism and transport in mitochondria with special reference to the possible relationship of tetrahydrofolates to electron transport and oxidative phosphorylation.

In both cases the research will be carried out in collaboration with Professor J. A. Blair & Dr P. A. Barford.

Appointment, which will be for one year in the first instance with annual renewal up to three years, will be on the salary scale commencing £2778-£3186 per annum, on a scale rising to £5022 per annum (+ £83·52 threshold payments).

Requests for full information and application forms (which should be returned not later than 3rd October, 1975), should be sent, preferably on a postcard quoting Ref. No. 5/6/52 to the Staff Officer, the University of Aston in Birmingham, Gosta Green, Birmingham B4 7ET.

LOUGHBOROUGH UNIVERSITY OF TECHNOLOGY

MATHEMATICS RESEARCH

Applications are invited from suitably qualified mathematicians for a Research Fellowship in the Department of Mathematics. The Fellowship is S.R.C. supported and is for three years duration.

Applicants should ideally be post-doctoral mathematicians who will work on the algebra of multivariable control systems in close collaboration with the Control Systems Centre at UMIST. Salary will be on a notional scale rising to £5022 plus threshold payments of £83.52.

Postcard requests for further details and application forms to Assistant Registrer (Establishment) ref: 75/7Ma (R).

Loughborough *Leicestershire*

THE UNIVERSITY OF NEWCASTLE UPON TYNE
TOTAL ENERGY

The Science Research Council have funded a three-year investigation under the direction of Dr I. Fells into "Total energy schemes and the public supply."

The grant provides two posts of Research Associate; one for a senior engineer (post-doctoral equivalent), starting salary £3308 (under review), and one for a graduate economist, starting salary £2118 (under review), each with threshold payments of £229 per annum and membership of the appropriate University superannuation scheme. Candidates could be eligible to work for higher degrees. Starting date is Autumn 1975. Applications, including a curriculum vitae and the names of three referees, should be sent as soon as possible to Dr I. Fells, Department of Chemical Engineering, The University, Newcastle upon Tyne, NE1 7RU.

FELLOWSHIP IN TELECOMMUNICATIONS

Radio Research Board Australia

As part of its activities designed to foster research in Telecommunications and Radio Science in the universities and other appropriate organisations, the Radio Research Board has established a Fellowship scheme. Under this scheme one fellowship may be awarded each year for full-time research by young scientists or engineers of exceptional promise and proven merit. These are postdoctoral awards tenable for a period of two or three years in an Australian university, approved research institute or industrial laboratory as determined by negotiation between the successful candidate and the Board. Tenure of a fellowship is expected to commence within nine months of the advice of the award.

QUALIFICATIONS: Radio Research Board Fellows will not be restricted in nationality, but it is hoped that they would remain in Australia for several years after completion of fellowship. They should have a Ph.D., or equivalent qualifications, in a pertinent discipline.

Awards will, in general, be restricted to applicants who are not more than 30 years of age on the date on which applications close.

STIPEND: $12,272 (Australian) per annum—increased to $13,234 p.a. at age 28 years. Stipend is subject to income tax.

ALLOWANCES are payable in respect of a Fellow's dependent spouse ($500 p.a.), each dependent child ($200), superannuation payments (up to ten percent of stipend), appropriate insurance coverage and necessary travel expenses. Host institutions may be paid an allowance towards the cost of supporting the Fellow.

APPLICATIONS: Persons interested in applying for the above fellowships should obtain application forms and a statement of the conditions of the award from the **Secretary, Radio Research Board, P.O. Box 225, Dickson, A.C.T. 2602 Australia.**

Applications close on 31st October, 1975.

STUDENTSHIPS

LOTHIAN REGIONAL COUNCIL
NAPIER COLLEGE OF COMMERCE AND TECHNOLOGY

A vacancy exists for

SRC CASE RESEARCH STUDENTSHIP IN THE DEPARTMENT OF CHEMISTRY

Applications are invited from persons suitable qualified under SRC regulations for a CASE Research Studentship leading to the degree of PhD.

The project would entail investigations into the mechanisms of plumbosolvency in drinking water and close co-operation with the Water Supply Services of the Lothian Region.

Applicants who should have or expect to obtain e good honours degree or its equivalent in chemistry should epply to **Dr G. H. W. Milburn, Head of Department of Chemistry, Napier College of Commerce and Technology, Colinton Road, Edinburgh EH10 5DT,** before 30 September, 1975.

FOR SALE

ELECTRONIC CALCULATORS SAVING UP TO **50%**

SCIENTIFIC		SCIENTIFIC			
TEXAS SR11	£28.50	NOVUS 6030	£40.70	HANIMEX ESR100	£29.50
TEXAS SR16	£32.50	" 6032S (102 Prog/Stat)	£68.55	HANIMEX ESR 1010	£32.50
TEXAS SR50A	£44.00	" 6025 (Prog/Financial)	£68.55	HANIMEX ESR Master	£35.50
" SR51 (3 Mem/Stat)	£65.00	HANIMEX ESF101	£29.50	HAND	
NOVUS 4510	£24.95	ROCKWELL 630	£39.50	CBM GL997R (¼/Mem)	£14.50
NOVUS 4515 (102 Prog)	£54.58	" 31R (Sq. Rt /Mem)	£19.90	ROCKWELL 20R1¼/Mem	£14.00
NOVUS 6020 (Financial)	£39.35	CBM 35R (Sq. Root)	£12.50	ROCKWELL 21R1¼/Mem	£18.45
				TEXAS 2550 (Mini Desk)	£24.00

All prices include P. & P. Add 8% V.A.T. Specification lists on request.
Access orders accepted by 'phone.

Tel: 01-455 9855

MOUNTAINDENE LTD.
50 Southway, London, NW11

University of Strathclyde

BIOCHEMICAL ENGINEER OR FOOD TECHNOLOGIST

An opportunity to enter a key, growing field of study by wey of e 15 month studentship in the field of energy analysis of milk products is offered to a candidate with a good honours degree. Study commencing in January 1976 or sooner will lead to an MSc and will include travel in the UK and abroad. Further enquiries and applications to **Professor J. Hawthorn, Department of Food Science and Nutrition, University of Strathclyde, James P. Todd Building, 131 Albion Street, GLASGOW G1.**

THE UNIVERSITY OF ASTON IN BIRMINGHAM

DEPARTMENT OF CHEMISTRY

Research Studentship in the Air Pollution

There is a vacancy for a research student to join the team in the Department of Chemistry studying air pollution in urban environments. The work involves investigating the reliability of sampling procedures for polynuclear hydrocarbons adsorbed air atmospheric particulates. Applicants should possess e good honours degree or equivalent in chemistry, physics or chemical engineering. The successful candidate will be expected to register for a higher degree.

Application forms are sveilable immediately from:

Dr J. D. Butler, Department of Chemistry, The University of Aston in Birmingham, Birmingham B4 7ET.

BOOKS AND PUBLICATIONS

NATURAL HISTORY

900 books. Especially on Darwinism and its philosophical consequences; also fine illustrated books. Prices: 50p-£1000. Catalogues sent free on request. M. E. Korn, 8 Rousden St., London NW1 0SU.

READ SATELLITE NEWS

every week: subs. £3 per year, aample 10p. G. Falworth, 12 Barn Croft, Preston PR1 0SX.

PERSONAL

Computer Dating

For free questionnaire and brochure write to: Dateline (NS), 23 Abingdon Road, London W.8. 01-937 0102

Dateline

Ariadne

The organic farming interests, accustomed to the scorn of the conventional agriculturalists, should take heart from a study (*Science*, vol 189, p 777) published by the Center for the Biology of Natural Systems at Washington University, St Louis, which is directed by the redoubtable Barry Commoner. Sixteen organic farms, all in the corn-belt states, were measured against conventional farms, similar in size, soil conditions, and location. The organic farmers fed most of their crops to cattle but had they sold them for cash, the researchers reckon, they would have earned $165 per acre—$14 less than the conventional farmers got. But organic men's operating costs were $16 less than those of the conventional farmers (who had fertiliser bills to meet). The incomes came out: $134 for organic, $132 for conventionals. On the energy count the organics were, of course, clear winners. The conventionals used 18 400 Btu's per dollar, the organics only 6800 Btu's. It is this sort of hard economic evidence—although the figures will undoubtedly be fought over—that organic people have always been weak on, falling back on dubious arguments about the innate "goodness" of the food they produce.

■

Do women, I asked recently, write science fiction? An informed (male) source hastens to assure me that they do. One of them, Ursula Le Guin, an American, has just won a leading award (the Nebula) for her novel *The Dispossessed* (published by Gollancz last year in Britain). This was her second Nebula; the first came in 1969 for her novel *The left hand of darkness*, which also won a 1970 Hugo award (the other major American science fiction honour). Ms Le Guin has picked up several Hugos for shorter works, but her British fans are more familiar with the *Earthsea* trilogy, three fantasies for children which seem to be a growing cult among adults.

■

Silk worms, it seems, are coming back. Having been written off as obsolete in the light of developments in artificial textiles, the worms could still provide revenue for developing countries. This rise of interest is demonstrated, perhaps, by the fact that the third international conference on the subject is being held this month at Tlemcen in Algeria. Apart from China, Japan and Italy the traditional sources, production has been rising in India and Russia. Brazil has taken it up and there are other places such as Lebanon and Madagascar where mulberry trees have been planted to supply silk farms with fodder. An article in *Le Monde* (27 August) gives some of the figures involved: 10 grammes of eggs (about 8500 in number) will yield 30kg of cocoons and finally 5kg of raw silk. This for an input of 1 tonne of mulberry leaves. The famous Lyons spinners were hit when disease decimated the French worms from 1853 until Pasteur found a cure in 1868. The following year, however, the Suez canal was opened and the Japanese worms arrived at a price no one could match. Much of the new technology still emerges from Japan—a hybrid worm, for instance, that produces a thread 1500 metres long instead of the usual 700 metres.

■

Awesome, those Japanese. The Mitsui company has created a science pavilion for children at an ocean exposition in Okinawa which contains, among other sources of amazement, an "Experimental Water Theatre" and a "Water Orchestra". I can't make out how the orchestra works except that it's a kind of hurdy gurdy driven by a water wheel. But the company's description of the theatre is admirably lucid. The stage is a pool holding 200 tons of water and the four-minute drama, endlessly repeated, starts with a series of concentric ripples which become disrupted by a gentle wind. Bubbles now rise from the bottom of the tank, making little evanescent domes on the surface. A torrent of rain from the roof and a rising wind cause bigger and bigger waves, until these are calmed by another eruption of bubbles. Then the mass of water starts to spin into a whirlpool which widens until all the water disappears through the walls. Then the whole process starts again. It sounds a charming idea.

■

My photojective friend Daedalus has set DREADCO chemists perfecting a new revolution in colour. He points out how hard it is to stop dyes fading slowly in the light, and argues that it should therefore be very easy to make them fade because some chemical bond in their molecule is broken ("photolysed") by light, and other nearby molecules latch onto the ends to create a colourless compound. Suppose, says Daedalus, you have a blue dye A (i.e. one reflecting blue and absorbing yellow), mixed with another compond B (the "fixer") which is broken apart by some artificial ultraviolet wavelength; and further suppose that the photolytic fragments from B can latch onto the broken ends of the light-sensitive bond of A. Now, irradiated by yellow light alone, nothing much happens to the mixture. The A bonds are broken, but in the absence of acceptor molecules they will just re-form again. But irradiated by yellow and u.v. together, the B fragments will latch onto the broken A bonds. The blue dye is permanently bleached, giving a yellow cast to any mixture containing it. The mixture has taken up the colour projected onto it! The DREADCO chemists are generalising this principle to mixtures of "fixer" with suitable red, green, and blue dyes. The mix absorbs all wavelengths and looks black. But exposed to light of any colour, together with the activating u.v. wavelength, the complementary shade will be bleached out, leaving a permanent copy of the chosen colour. Thus will be developed the DREADCO decorative dream. Cars, clothes, houses, all will be painted or dyed with the all-purpose pigment, and later coloured to the owner's requirements by simple projectors. Adjust the light to the colour you want; mix in the u.v. and there it is! Even wallpaper and dress-fabric will be sold black, leaving the customers to image on it their own designs, slogans, floral patterns, holiday snaps, portraits of the Queen, etc., chosen at leisure. Women who crave wild contrasts, or colour-matching coordinated everything, would revel in a new paradise. And the wildest decorative experiments could be cheerfully tried, because aesthetic disasters could always be erased by exposing them to the u.v. and broad-spectrum light together, bleaching the whole mess white.





ICI KNOW HOW TO TREAT A LADY

'Aphox' and 'Rapid' kill aphids, won't harm their natural enemies.

Insecticides that kill at random inevitably destroy allies along with foes – something no farmer wants to do. That's why ICI developed 'Aphox' and 'Rapid', selective insecticides based on pirimicarb, that kill harmful aphids without harming the ladybirds that prey on them, or the bees that pollinate the blossoms. Every year these and other ICI Plant Protection products earn Britain millions of pounds in exports – the 1973 figure was £50 million – and give farmers and gardeners all over the world better, more abundant crops. They're another example of ideas in action – from ICI.

ICI **Ideas in action.**





Say the magic word – Diffstak® – and you've brought your pumping problems down to size!

Diffstak® – the biggest advance in vacuum pumping systems for years

Diffstak® is an exciting new concept – a 3 stage diffusion pump, optically opaque water cooled baffle, quarter swing valve and roughing line ALL INTEGRATED IN A SINGLE CASING.

SMALLER – a very much smaller overall height than that previously obtainable – an important feature when complete vacuum systems are being considered.

CLEANER – all the advantages of stainless steel construction, really effective baffling and polyphenyl ether pumping fluid, which, combined with the big reduction of system seals gives really clean vacuum.

FASTER – up to 100% increase in pumping speed over a comparable combination of pumps and baffles and valves.

CHEAPER – competitive prices and low installation costs make Diffstak® today's best value in pumping systems.

For all the details ask now for Publication 05759.



Edwards

Edwards High Vacuum
(Part of BOC Limited)
Manor Royal, Crawley, West Sussex, RH10 2LW, England
Tel: Crawley 28844 (STD Code 0293) Telex: 87123 Edhivac Crawley

P1617